Vol. 12, No. 6
March 31, 1987

Energy Research Abstracts

Abstracts 10692-13013

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

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The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)*–PB87-900700.** Technology required for energy conservation in buildings of all types.

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***Coal Combustion and Utilization (CCU)*–PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB87-900500.** Heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

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The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates—UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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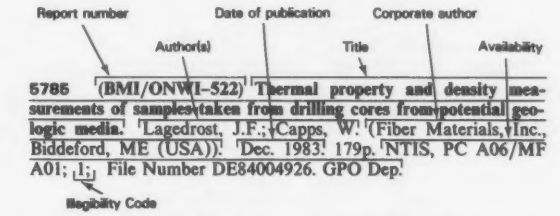
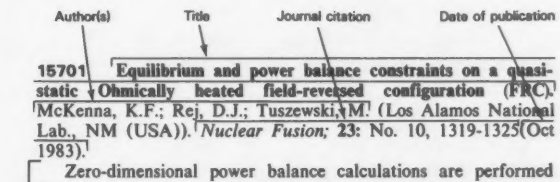
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Legibility Code

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

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DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
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• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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National Institutes of Health
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NOVA Information Services Company
Commack, NY

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 41 first-level and 276 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

10692 (DOE/METC—87/6072) FY86 Technology Transfer Program Morgantown Energy Technology Center. (USDOE Morgantown Energy Technology Center, WV). Oct 1986. 85p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87001001.

The actual technology transfer was accomplished by several integrated activities during fiscal year (FY) 1986: R & D contracts with industry and academia, including cost-shared contracts; technical information exchange for scientist-to-scientist communication through conferences, visitors to the Center, and federal personnel visits with US industry; technical documents for information dissemination; patents to advance technology adoption and use in US industry; on-site training activities as personnel exchange; and technical assistance through the use of fossil energy technology data bases.

10693 (KTM/E-D—101) Coal products and their utilization. Aeijaelae, M.; Rautalin, A.; Nikkilae-Panula, E.; Moilanen, A.; Thun, R. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 38p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750660.

Coal products and, in particular, centralized produced coal power and crush can be used as a fuel of small and medium-sized district heating and industrial boilers in the coastal areas of Southern Finland. Their competitiveness compared to other fuels is good in certain objects of use and on certain conditions. Centralized produced coal powder is competitive in certain areas in Finland, and coal-water slurries can be used in certain defined special cases. The use of coal-water slurries and coal powder as reserve fuel for milled peat, to replace buffer storages of peat, is profitable on certain conditions, in particular, if these products are already manufactured and this basic production is profitable. The profitableness of the use as reserve fuel is improved, if the coal products can be used for replacing oil as reserve fuel for milled peat. The most crucial technical problems related to the production, use and transports of coal powder and crush were solved during the work experimentally or by acquiring the information required. Problems related to coal handling and safety-technology have been of particular interest. Data on coal-water slurries were acquired both experimentally and through information services. Wear of burners is still a technical problem in the use of coal-water slurries. All technical data obtained in the research work is not published, as it is in the possession of the main financer, Neste Oy. Detrimental substances dissolved from coal ash in water scrubbing systems have also been determined. The need for information on different coal grades is increasing in Finland. To meet this need, a data bank on coal characteristics was established in the Laboratory of Fuel Processing and Lubrication Technology Research Centre of Finland. uring this work data on connections between the coal grade and operation-technical factors were also collected and the capability for coal analyses and studied was improved.

10694 (ORNL/FMP—86/4) AR and TD Fossil Energy Materials Program: Quarterly progress report for the period ending September 30, 1986. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 402p. NTIS, PC A18/MF A01. File Number DE87004050.

The objective of the AR and TD Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The program includes research aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. The management of the Program has been decentralized to the DOE Oak Ridge Operations Office (ORO) and the Oak Ridge National Laboratory (ORNL) as technical support contractor. The ORNL Fossil Energy Materials Program Office compiles and issues this combined quarterly progress report from camera-ready copies submitted by each of the participating subcontractor organizations. It is the intent of the AR and TD Fossil Energy Materials Program to sponsor materials research which is generic to a number of fossil energy technologies. It is hoped that this series of AR and TD Fossil Energy Materials Program quarterly progress reports will aid in the dissemination of information developed on the program. Plans for the program are issued annually. The implementation of these program plans will be reflected by these quarterly progress reports, and this dissemination of information will be augmented by topical or final reports as appropriate.

0103 Preparation

REFER ALSO TO CITATION(S) 10748, 10784, 10805

10695 (CANMET—86-5) Canadian coal preparation plants. Romaniuk, A.S. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jun 1986. 78p. (In English, French, German and Russian). Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Fourteen Canadian coal preparation plants are described in terms of their geographical setting and transportation facilities, special technology features, and a flow sheet subdivided into four parts: pretreatment of feed coal, cleaning, subsequent treatment of products, and storage and loading. The plants discussed have been grouped into four geographical regions: the Wolverine area in northeastern B.C.; the East Kootenay area, in southeastern B.C.; the Yellowhead area in west-central Alberta; and, Cape Breton in Nova Scotia.

10696 (DOE/PC/80525—T5) Three-dimensional structure of flow in coal-cleaning cyclones: Technical progress report No. 5, September 1, 1986-November 30, 1986. Hwang, C.C.; Chiu, C.L. (Pittsburgh Univ., PA (USA). School of Engineering). 23 Dec 1986. Contract FG22-85PC80525. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003793.

During the fifth report period, major tasks included: (1) a search for experimental data that may be available for verifying the simulation technique developed, and (2) obtain preliminary experimental data using a model hydrocyclone with an apex angle of 30°. 3 figs.

10697 (EPRI-AP—4905) Low-rank coal-water slurries for gasification: Phase 2, analytic studies: Final report. Baker, G.G.; Farnum, S.A.; Maas, D.J.; Mayer, G.G.; Potas, T.A.; Sears, R.E.; Tye, C. (North Dakota Univ., Grand Forks (USA). Energy Research Center; Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 147p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920145.

A laboratory-scale study was conducted to compare alternate methods for thermally dewatering low-rank coal (LRC) as prospects for the preparation of LRC/water slurries for gasification. Conventional, hydrothermal, and high-temperature evaporative coal drying methods were investigated and modern analytical methods were used to characterize coal both before and after thermal treatment. Results showed that the moisture in low-rank coal may all be removed by conventional drying practices, however, it

is rapidly reabsorbed when the dried coal is slurried in water. Several changes in the chemical and physical properties of low-rank coal were found important for preventing moisture reabsorption and for enhancing its slurring characteristics. These were: (1) decarboxylation of the coal to reduce the number of polar sites to which water is attracted; (2) removal of water-soluble inorganics; and (3) devolatilization of the coal to produce tars and waxes which can coat the surface of the coal and plug micropore entrances, all of which appear to inhibit moisture reabsorption and/or lower the viscosity of the coal/water mixture. The hydrothermal and high-temperature evaporative coal drying methods were found to be effective in causing some or all of these changes, and for increasing the propensity of low-rank coal for coal/water slurry applications, especially making it a viable feedstock for slurry-fed gasifiers. In effect, the equilibrium moisture content of low-rank coals was permanently reduced, by converting the coals from a hydrophilic to a hydrophobic substance. This makes it possible to form concentrated slurries using only slightly more water than that inherently found in the coal. 50 refs., 43 figs., 37 tabs.

10698 **(EPRI-CS—4975) Economic evaluation of micro-fine coal-water slurry: Final report.** Margulies, A.E. (Stone and Webster Engineering Corp., Boston, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 59p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920150.

The replacement of No. 6 oil with coal in oil/gas design boilers results in problems due to coal ash impacts of deposition and erosion. This necessitates increased boiler conversion costs and/or extensive capacity derating. An approach to minimize such penalties is to micropulverize the coal to a top size of 325 mesh for use in a coal-water slurry (CWS) fuel form. These benefits could not be realized in the past because inadequate atomization of the slurry caused the fine coal particles to agglomerate. However, recent tests have shown that heating such micronized CWS (MCWS) fuel can yield a higher carbon burnout and a finer flyash particle size than obtained with "normal" grind or conventional pulverized CWS (CCWS) fuel. This approach will minimize capacity derating. The report assesses potential user cost savings for converting an oil/gas design power plant is micronized versus conventional pulverized grind coal-water slurry fuel.

10699 **(ERP/CRL—86-9(TR,J)) Numerical evaluation of coal preparation density separators performance.** Salama, A.J.A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jan 1986. 13p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Numerical methods are developed for evaluating density separation efficiency. The methods presented can be easily implemented on digital computers and provide the coal preparation engineer with a tool for quick evaluation of separation efficiency. 3 refs.

10700 **(SCOAL—8601) Impact roller tests on discard coal at Van Dyks Drift Colliery.** Coetzee, S.D.; Clifford, J.M.; Skultety, J. (National Inst. for Coal Research, Pretoria (South Africa); National Inst. for Transport and Road Research, Pretoria (South Africa)). Jul 1986. 38p. National Institute for Coal Research, Pretoria, South Africa.

Describes tests carried out to compare the discard compacting performance of a tractor-towed roller with that of a vibrating roller. The objective was to test whether the impact roller, previously shown to be capable of effecting significant cost savings in coal stockpile compaction, could be equally effective in compacting coal preparation discards. The trials demonstrated the impact roller to be capable of rapidly compacting Van Dyks Drift discard coal, as a result of its ability to effectively compact layers (lifts) of up to 2 m thickness, and at a travel speed greater than that of other compactors. The impact roller had an output or productivity of the order of 10 times that of the vibrating roller used for compaction. 4 figs., 21 tabs.

0104 Processing

REFER ALSO TO CITATION(S) 10743, 10750, 10762, 10764, 10827, 10829, 10881, 10882, 11008, 11152, 12018

10701 **(DOE/ET/10532—T34) Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes: Fourteenth interim report, Processing of Wyodak CTSL [catalytic two-stage liquefaction] oil and related experimental studies.** Sullivan, R.F. (Chevron Research Co., Richmond, CA (USA)). Aug 1986. Contract AC22-76ET10532. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003103.

Syncrudes produced from Wyodak coal in the Catalytic Two-Stage Liquefaction (CTSL) process were upgraded in pilot plant tests by hydrotreating with Chevron's commercial ICR 106 catalyst. Two CTSL syncrudes were studied; the first had an end point (EP) of about 625°F; the second, an EP of about 850°F. In this report, results are compared to those obtained with syncrudes from single-stage liquefaction processes and another two-stage process [Integrated Two-Stage Liquefaction (ITSL)]. In general, products from the two-stage liquefaction processes were easier to upgrade than those from single-stage processes. However, with all of the syncrudes, relatively small increases in EP made the oils more difficult to hydrotreat. The 625°F EP CTSL was the easier to upgrade than the other syncrudes because of its relatively low EP and low heteroatom and high hydrogen contents. Both of the CTSL syncrudes were upgraded in a single hydrotreating step to diesel fuel, jet fuel, and a naphtha suitable for catalytic reforming. However, for the higher EP syncrude, the preferred route also required either a hydrocracking step or a second hydrotreating step. Transportation fuels made from all the syncrudes were fairly similar. Mainly, they were composed of cyclic hydrocarbons. There were, however, differences in product distributions depending upon syncrude boiling ranges. The middle-distillate fuels (jet and diesel) had high densities and, therefore, high volumetric energy contents. 14 refs., 16 figs., 49 tabs.

10702 **(DOE/ET/14928—2233) System analysis of simplified IGCC [Integrated Gasification Combined Cycle] plants.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Sep 1986. Contract AC21-80ET14928. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002508.

The Integrated Gasification Combined Cycle (IGCC) has been identified as an advanced coal-to-electricity power generation system with the potential for attractive performance and economic characteristics. A 100 MW demonstration of this concept has been constructed on the Southern California Edison utility system and is supplying electrical output to the grid with excellent availability. With this successful demonstration accomplished, approaches are being evaluated that will retain the attractive operational and environmental characteristics of the IGCC system while offering the potential for increased efficiency and reduced capital cost. The current system evaluation study has focused on developing the performance and economic advantages of these simplification techniques. The simplified IGCC system attempts to achieve reduction in capital cost through elimination of a number of major plant elements while maintaining or increasing the plant efficiency. The elements in the gasification subsystem are simplified by air blowing the gasifier and providing the coal in a dry feed system. By using a fixed-bed gasifier, the gas outlet temperature is reduced to a point where gas cooling is not required and the cleanup functions are performed at gasifier exit temperature directly. When these modifications are employed, the process flow schematic is reduced in complexity. Taking the simplification concept one step further, the power generation system can be modified to include direct combustion of the high-temperature coal gas without any additional heat exchange. The steam generated in the heat recovery steam generator can also be injected into the gas turbine flow path (eliminating the steam turbine) or used in a conventional steam turbine bottoming plant. 42 figs., 43 tabs.

10703 **(DOE/FC/10601—2230) Kinetic model development for low-rank coal liquefaction: Quarterly technical progress report for the period April 1, 1986-June 30, 1986.** Anthony, R.G.; Moore, P.K. (Texas A and M Univ., College Station (USA). Kinetics, Catalysis, and Reaction Engineering Lab.). Aug 1986. Contract AC21-83FC10601. 176p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003706.

During the past quarter, research was directed toward the kinetic modeling of coal liquefaction reactions. Specifically, a new lumping system, abstract-discrete lumping, was developed and tested for a vapor-liquid equilibrium calculation. The abstract-discrete method combines the advantages of traditional pseudo-component lumping with the advantages of continuous lumping. The method is especially applicable to mixtures for which the analytical data consist of partially-resolved chromatograms, such as for the size-exclusion chromatographic analysis of coal liquids. This report records the development and testing of the theory behind the abstract-discrete approach. Although the derivation of the method utilizes mathematical concepts which may at times seem difficult, the final result consists of simple algebraic equations which may be solved with only a little more difficulty than the classical equations. The theory has first been developed for a vapor-liquid equilibrium calculation. The reason for this is two-fold. First, the vapor-liquid equilibrium equations are generally simpler than kinetic modeling equations, a fact which makes the description of the theory much easier. In addition, vapor-liquid equilibrium effects are of importance to liquefaction reactor modeling, and are to be incorporated into the tubing-bomb reactor model presently under development. We have shown that vapor-liquid equilibrium calculations based upon a thermodynamic equation-of-state can predict the hydrogen composition of the liquefaction-reactor liquid phase with considerable accuracy. 7 refs., 40 figs., 49 tabs.

10704 **(DOE/FC/10620—2234) Pulsating gasification of low rank coals: Quarterly technical progress report for the period July 1, 1986-September 30, 1986.** Zinn, B.T.; Powell, E.A.; Narayanaswami, L.L. (Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering). Jun 1986. Contract AC21-84FC10620. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003501.

This report describes the research progress accomplished during the eighth quarter of the contract, which has been extended to ten quarters. The parametric studies were continued during this quarter to obtain steady state solutions for gasifiers without devolatilization, for gasifiers with inlet reservoir devolatilization, and for longer gasifiers than previously investigated. These steady state solutions were then used as a reference base for studying the effects of large amplitude pulsations on gasifier performance. The effect of inlet particle temperature, inlet oxygen mass fraction, and gasifier length on the growth or decay of the acoustic oscillations was determined. In all cases considered so far the amplitude of the oscillations decayed with time. Finally, the report presents the progress achieved in the experimental phase of the project. 1 ref., 14 figs., 2 tabs.

10705 **(DOE/FE/60177—2249) Physical simulations of underground coal gasification in an eastern bituminous coal.** Glaser, R.R.; Johnson, L.A. (Western Research Inst., Laramie, WY (USA)). Jun 1986. Contract FC21-83FE60177. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004290.

A series of laboratory experiments has been conducted at the Western Research Institute to simulate the underground gasification of Herrin No. 6 bituminous coal. The samples were provided by Peabody Coal Company from its River King 3 mine near New Athens, Illinois. The program was conducted under a cooperative agreement with the US Department of Energy. The series consisted of three bench-scale tests, in which 1.5-ft (46 cm) coal cubes were used, and a large block test in a pilot-scale reactor. The large block was 2 ft (60 cm) high, 2 fit (60 cm) wide, and 4.5 ft (140 cm) long. The weakly swelling coal was gasified using steam and oxygen ratios ranging from 0.5/1 to 2/1 (steam/oxygen by volume). A nitrogen and oxygen mixture (2/1 by volume, nitrogen/oxygen) was tested for comparison with the steam/oxygen tests. Gasification of the small blocks typically consumed 20 lbs (9 kg) of coal and gasification of the large block consumed 150 lbs (68 kg). Small changes in the gas heating values were noted at the different steam/oxygen ratios. However, all of the tests produced a gas with a nitrogen-free dry heating value near 200 Btu/scf (176 KJ/mol). 9 refs., 4 figs., 4 tabs.

10706 **(DOE/MC/22250—2215) Alternative flow control nozzles/energy dissipation of highly erosive fluids: Final report.** Maddox, P. (Transamerica Delaval, Inc., Trenton, NJ (USA). Biphase Energy Systems Div.). Sep 1986. Contract AC21-86MC22250. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001025.

An innovative Flow Control Device (FCD) utilizing multiple pairs of opposed coaxially-aligned nozzles was successfully tested in a three-phase erosive-flow stream. A mixture of air, water, and silica was selected to produce velocities representative of those resulting in a high-pressure letdown coal-liquefaction process. Aluminum was utilized for test hardware to provide accelerated erosion data. A globe valve with aluminum trim was tested at the same operating conditions to provide baseline performance data for direct comparison with nozzle results. The time rate of increase in flow-control area of the FCD was less than one third that of the globe valve. This demonstrates the relative severity of impingement erosion over scouring erosion, as there are no abrupt directional changes in the nozzle flow. The receiver walls showed no erosion damage for liquid levels well below the nozzle exit, indicating very efficient energy dissipation in the jet-impact zone. These favorable results coupled with the design simplicity of the FCD provides a solid basis for further development. 15 refs., 33 figs., 4 tabs.

10707 **(DOE/METC—86/2019) On-line measurement of the alkali and particulate loading of the process stream of a fixed-bed gasifier: Research report.** Woodruff, S.D.; Pineault, R.L.; Romanosky, R.R.; Anderson, R.J. (USDOE Morgantown Energy Technology Center, WV). Oct 1986. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86001041.

On-line analytical instrumentation developed at the US Department of Energy's Morgantown Energy Technology Center (DOE/METC) to monitor particle and alkali loading was successfully used on the process stream of a coal gasifier to measure contaminant levels before and after combustion of the coal gas in a turbine-simulator combustor at the General Electric Research Laboratories in Schenectady, New York. A two-color laser transmissometer was designed and built to simultaneously measure particle median size and number density in situ in a highly loaded gas process stream. Four of the instruments successfully monitored particle number density at different locations on the coal gasifier-combustor system. The particle loading measurements ranged from 150 ppM to greater than 1000 ppM. Temporal variations observed in the particle loading data correlated with physical events perturbing the gasifier system. A fiber-optic flame atomic emission spectrometer was designed and built to measure sodium and potassium concentrations in gas samples extracted from the process stream. Two of the instruments and an earlier system built at Ames Laboratory at Iowa State University successfully measured alkali levels before and after the combustor using an extractive probe. The alkali monitors found contaminant levels in the fuel gas lower than values determined from extractive filter samples, the average value being 48 ppB total alkali. The ratio of sodium to potassium was constant across the combustor. 8 refs., 12 figs., 3 tabs.

10708 **(DOE/METC—86/6043) Proceeding of the sixth annual gasification contractors meeting.** Ghate, M.R.; Baker Jarr, L.A. (eds.). (USDOE Morgantown Energy Technology Center, WV). Jun 1986. 405p. (CONF-860649—). NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE86006617.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

On June 24 and 25, 1986, METC sponsored the Sixth Annual Gasification Contractors Meeting which was held at the Ramada Inn in Morgantown, West Virginia. The primary purpose of the meeting was threefold: to review the technical progress and current status of the gasification projects sponsored by the Department of Energy. To foster technology exchange among participating researchers and other technical communities. To facilitate inter-

active dialogues which would identify research needs that would make coal based gasification systems more attractive economically and environmentally. More than 170 representatives of Government, academia, industry, and overseas coal research organizations attended the 2-day meeting. Twenty-nine papers and nine poster displays were presented summarizing recent developments in fundamental mechanisms/innovative concepts, fluid dynamic/modeling, gas separation/upgrading, and operating experience of the large-scale pilot plants in the US Scientists, engineers, and administrators discussed many of the issues facing those engaged in the research and development activities that constitute the gasification program. This document constitutes the proceedings of that meeting and serves as a summary of the gasification program. Selected papers have been processed for inclusion in the Energy Data Base.

10709 **(DOE/METC—86/6049) Extractors manual for Integrated Gasification Combined Cycle Data Base System: Major Plants Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Nov 1986. Contract AC21-85MC21353. 498p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE86006553.

National concern over the depletion of conventional energy sources has prompted industry to evaluate coal gasification as an alternative source of energy. One approach being evaluated is gasifying coal in a gasifier and feeding the fuel gas to a combined-cycle power plant. This system is called an Integrated Gasification Combined-Cycle (IGCC) power plant. The US Department of Energy (DOE) is also encouraging the development of new technologies by sponsoring research and development (R and D) projects in IGCC. In order to make data generated from these projects available to government and private sector personnel, the IGCC Data System has been established. A technology-specific data system consists of data that are stored for that technology in each of the specialized data bases that make up the Morgantown Energy Technology Center (METC) data system. The IGCC Data System consists of data stored in the Major Plants Data Base (MPDB) and the Test Data Data Base (TDDB). To capture the results of government-sponsored IGCC research programs, documents have been written for the MPDB and TDDB to specify the data that contractors need to report and the procedures for reporting them. The IGCC documents identify and define the data that need to be reported for IGCC projects so that the data entered into the TDDB and MPDB will meet the needs of the users of the IGCC Data System. This document addresses what information is needed and how it must be formatted so that it can be entered into the MPDB for IGCC. The data that are most relevant to potential IGCC Data System users have been divided into four categories: project tracking needs; economic/commercialization needs; critical performance needs; and modeling and R and D needs. 4 figs., 28 tabs.

10710 **(DOE/METC—86/6050) Extractors manual for Integrated Gasification Combined Cycle Data Base System: Test Data Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Nov 1986. Contract AC21-85MC21353. 437p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE86006554.

National concern over the depletion of conventional energy sources has prompted industry to evaluate coal gasification as an alternative source of energy. One approach being evaluated is gasifying coal in a gasifier and feeding the fuel gas to a combined-cycle power plant. This system is called an Integrated Gasification Combined-Cycle (IGCC) power plant. The US Department of Energy (DOE) is also encouraging the development of new technologies by sponsoring research and development (R and D) projects in IGCC. In order to make data generated from these projects available to government and private sector personnel, the IGCC Data System has been established. A technology-specific data system consists of data that are stored for that technology in each of the specialized data bases that make up the Morgantown Energy Technology Center (METC) data system. The IGCC Data System consists of data stored in the Major Plants Data Base (MPDB) and the Test Data Data Base (TDDB). To capture the results of government-sponsored IGCC research programs, documents have been written for the TDDB and MPDB to specify the data that contractors need to report and the procedures for reporting them. The IGCC documents identify and define the data that need to be reported for IGCC projects so that the data entered into the TDDB and MPDB will meet the needs of the users of the IGCC Data System. This document addresses what information is needed and how it must be formatted so that it can be entered into the TDDB for IGCC. The data that are most relevant to potential IGCC Data System users have been divided into four categories: project tracking needs; economic/commercialization needs; critical performance needs; and modeling and R and D needs.

10711 **(DOE/PC/50041—71) Wilsonville Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama. Run 248 with Illinois No. 6 coal. Technical progress report.** (Catalytic, Inc., Wilsonville, AL (USA)). Sep 1986. Contract AC22-82PC50041. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87000959.

This report presents the operating results for Run 248 at the Advanced Coal Liquefaction R & D Facility in Wilsonville, Alabama. The run began on 8 February 1985 and continued through 5 May 1985. A total of 170 tons of Illinois No. 6 bituminous coal was fed in 1904 hours of operation. The primary run objectives included the demonstration of unit and system operability for bituminous coal with the low-contact time (LCT) reactor in place at the thermal liquefaction unit (TLU) in both the Double Integrated Two-Stage Liquefaction (DITSL) and Integrated Two-Stage Liquefaction (ITSL) modes of operation. Operating conditions were adjusted to obtain high coal conversion, acceptable deashing performance and an "all-distillate" product slate. Material balances were defined for five special product workup periods. 6 refs., 19 figs., 28 tabs.

10712 **(DOE/PC/50041—75) Run 249 with Wyodak coal. Technical progress report.** (Catalytic, Inc., Wilsonville, AL (USA)). Oct 1986. Contract AC22-82PC50041. 167p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002268.

This report presents the operating results for Run 249 at the Advanced Coal Liquefaction R and D Facility in Wilsonville, Alabama. This run operated in a Two-Stage Liquefaction (TSL) mode using Wyodak subbituminous coal from the Clovis Point mine. The primary run objective was demonstration of unit and system operability for subbituminous coal in the Reconfigured Integrated Two-Stage Liquefaction (RITSL) mode of operation with a forced back-mixed dissolver in the thermal liquefaction unit. In RITSL the products from the thermal (first stage) unit are sent to the hydrotreater (second stage) unit without prior deashing. The hydrotreated resid and ash are sent to the Critical Solvent Deashing unit, and the deashed resid is then recycled to the thermal unit. Run 249 began on 1 June 1985 and continued through 18 September 1985. During this period 290 MF tons of coal were fed in 2370 hours of operation. Operating conditions were adjusted to obtain high coal conversion, acceptable deashing performance, and an "all-distillate" product slate. Included in Run 249 were evaluations of the effects of iron oxide, dimethyl disulfide, and water as reaction additives on coal conversion, product quality gas make, catalyst activity, and energy rejection. A test of ash recycle was also included in the run. 9 refs., 31 figs., 33 tabs.

10713 **(DOE/PC/50791—T5) Fischer-Tropsch synthesis from a low H_2:CO gas in a dry fluidized-bed system. Volume 1. Project summary. Final technical report, October 1, 1986.** Liu, Y.A.; Squires, A.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemical Engineering). 1 Oct 1986. Contract FG22-82PC50791. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87000286.

The objective of this project is to experimentally develop and demonstrate a dry fluidized-bed reactor system (called "heat tray") for Fischer-Tropsch synthesis from a low H_2:CO gas. The reactor involves conducting catalytic synthesis reactions primarily in a horizontal conveying zone, in which fine particles of an iron catalyst are carried in a relatively dilute suspension by a large flow of reacting gas. A secondary reaction zone, in the form of a shallow fluidized bed of catalyst particles, is situated beneath the primary reaction zone. This shallow bed also has immersed horizontal heat-transfer tubes for removing reaction heat. A major thrust of the new reactor development is to prevent carbon deposits from

forming on the iron catalyst, which cause deactivation and physical degradation. This is to be achieved by conducting the Fischer-Tropsch synthesis in an unsteady-state mode, particularly by alternately exposing the iron catalyst to a large flow of low H_2:CO gas for a short period of time and to a small flow of H_2-rich gas for a long period of time. The project has been carried out in two key tasks: (1) development of a microreactor system for unsteady-state Fischer-Tropsch synthesis, simulating the life history of an iron catalyst particle in a "heat-tray" reactor; and (2) supporting fluidization studies. The present Volume I summarizes the key conclusions and recommendations from this project, and the accompanying Volumes II and III describes the details of experimental investigations and results. 12 refs., 8 figs., 2 tabs.

10714 **(DOE/PC/50791—T6) Fischer-Tropsch synthesis from a low H_2:CO gas in a dry fluidized-bed system. Volume 3. Heat transfer between a supernatant gas and a flowing shallow fluidized bed of solids. Final technical report, October 1, 1986.** Boyd, J.H.; Liu, Y.A.; Squires, A.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemical Engineering). 1 Oct 1986. Contract FG22-82PC50791. 316p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87000288.

Volume II describes the details of heat-transfer studies in a dry fluidized-bed system (called "heat tray"), which has been proposed for heat recovery from hot gases and for heat management in exothermic reactions. In particular, this report presents the results of bench-scale and pilot-scale experimental studies which quantify heat transfer between a hot supernatant gas (S-gas) and a flowing shallow fluidized bed of solids. A fractional-factorial design of experiments has been performed on two heat-tray systems using three different solids. The results show that fine fluid cracking catalyst (FCC) particles out-perform larger alumina spheres as a fluidized solid. Heat transfer coefficients between the supernatant gas and the shallow fluidized bed approaches 440 W/m^2-K using FCC with a heat-exchange area of 0.124 m^2. Various S-gas inlet nozzle configurations have been studied, with a nozzle height equal to one-half of the static bed height (0.051 m) giving the best results. The study shows that short heat-tray lengths (< 0.8 m) are desirable and that S-gas redistributors are needed to compartmentalize the unit. An economic analysis shows that the proposed heat tray would be economically feasible for adaption as a boiler feedwater preheater in a small steam-generation facility, using boiler combustion gases as the S-gas. The payback time for the system would be as short as 1.9 years when used continuously. The heat transfer results from a supernatant gas to a flowing shallow fluidized bed represent the only data reported thus far, and have led to a better understanding of the heat management in the proposed "heat-tray" reactor for Fischer-Tropsch synthesis. 20 refs., 46 figs., 15 tabs.

10715 **(DOE/PC/50798—T15) Catalyzed gasification of coal: Isotope and XPS studies: Final report, July 15, 1982-October 15, 1986.** Falconer, J.L. (Colorado Univ., Boulder (USA)). 15 Dec 1986. Contract FG22-82PC50798. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003402.

This research aims to elucidate the reaction mechanism for the catalytic gasification of coal by metal carbonates, by identifying the reaction pathways and the active form of the catalyst. The insight into the mechanism will help in improving process kinetics of coal gasification. Alkali carbonates and alkaline earth carbonates are being used to catalyze the carbon dioxide-carbon gasification reaction. Temperature-programmed reaction, isotopic labeling of the carbon and oxygen atoms in the carbonate, and mass spectrometric detection of labeled products are used to identify reaction pathways. X-ray photoelectron spectroscopy (XPS) analysis of carbon-carbonate mixtures is used, at reaction conditions, to determine the chemical state of the carbonate.

10716 **(DOE/PC/60800—12) Active sites in char gasification: Quarterly technical progress report, 1 July 1986-30 September 1986.** Calo, J.M.; Suuberg, E.M.; Wojtowicz, M. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1986. Contract FG22-83PC60800. 27p. NTIS, PC A03. File Number DE87003989.

This report focuses on the order of reaction in low temperature oxidation of the model chars that are of interest in this work. It should be recalled that our focus has shifted to understanding the low temperature chemisorption processes sometimes used to characterize active sites in chars. It should be remembered that it has been previously demonstrated that along with low temperature chemisorption, "young" chars show simultaneous loss of carbon oxides, under certain conditions that have sometimes been reported to give "irreversible" oxygen uptake. Here, we seek to learn more about the rates of such low temperature gasification processes, and what distinguishes chars which show truly irreversible sorption from those that gasify at low temperatures. This is in keeping with the general scope of the project, in trying to identify what precisely are active sites, and how they are created and/or destroyed. 14 refs., 4 figs., 6 tabs.

10717 **(DOE/PC/60805—T12) Cation promotion effect in zeolite-supported F-T catalysts: Final report.** Goodwin, J.G. Jr.; Oukaci, R. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 31 Aug 1986. Contract FG22-83PC60805. 236p. NTIS, PC A11/FA01; 1; GPO Dep. File Number DE87002505.

The present work was undertaken to investigate systematically the influence of Group IA neutralizing cations on CO hydrogenation over zeolite-supported ruthenium catalysts. These catalysts were prepared from NH_4Y, LiY, NaY, KY, RbY, CsY, NaX, KL, and Na-mordenite zeolites by ion exchange with ruthenium hexammine chloride. The nature of the group IA cations was found to have little effect on chemisorptive properties and on the activity and chain growth probability in CO hydrogenation on Ru. However, it was established that secondary acid-catalyzed reactions of the primary olefinic products from CO hydrogenation can play a major role in shaping product selectivity. Using model reactions such as olefin transformations on the zeolites without the metal, it was established that the strength of the acid sites is a strong function of the nature of the neutralizing alkali cations remaining in the zeolite. Acid site strength was found to decrease with molecular weight of the alkali cation used. This study established the bifunctional nature of the zeolite-supported F-T catalysts and its importance in CO hydrogenation. The results suggest that the catalyst selectivity can be controlled by varying the strength of the zeolite acid sites, the most important active centers for secondary reactions of the primary olefinic F-T products. Depending on the concentration and the strength of the acid sites, a function of the Si/Al ratio and the nature of the residual neutralizing cations, various competitive reaction paths can be observed for the transformation of olefinic compounds. These include isomerization, oligomerization, cracking, hydrogen transfer, etc. 67 figs., 32 tabs.

10718 **(DOE/PC/70753—T9) The study of some transition metals complexes as process catalysts: Quarterly report for the period September 30, 1986 through November 30, 1986.** Wilson, B.L. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 1986. Contract FG22-84PC70753. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003423.

During this past quarter, iron complexes with poly(pyrazolyl) borate ligands were prepared. Molybdenum complexes are under investigation by infrared and proton NMR. Cobalt complexes were fully characterized and tested as coal catalysts under various conditions. Nickel and iron complexes were evaluated along with $FeCl_3$ x $6H_2O$, $NiCl_2$ x $6H_2O$ and potassium dihydrobis(pyrazolyl) borate as liquefaction catalysts. All of the above mentioned complexes have the poly(pyrazolyl) borate ligands. Table 5 lists and compares the data for various analytic liquefaction runs on Illinois Number Six River King coal with SRC-II distillate. 8 figs., 10 tabs.

10719 **(DOE/PC/70780—T5) Trifunctional catalysts for conversion of syngas to alcohols: Ninth quarterly report for period September 1 to November 30, 1986.** Bischoff, K.B.; Manogue, W.H.; Mills, G.A. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 30 Dec 1986. Contract FG22-84PC70780. 15p. NTIS, PC A02. File Number DE87003682.

Measurement of infrared spectra of chemisorbed CO were used to characterize two series of rodium-alumina catalysts, one

series modified by molybdena and the other modified by sodium addition. Measurements were made first at 30°C, then at increasing temperatures, and thirdly after treatment with hydrogen. Significant differences were found for the appearance and stability on these catalysts of the three types of sorbed species - bridged, linear and gem-dicarbonyl. In additional infrared work, the deconvolution of spectra, having three peaks corresponding to the three types of species, revealed the presence and location of five peaks, representing species which have been tentatively identified. 7 figs.

10720 **(DOE/PC/70788—T5) Kinetics and FTIR studies of hydrocarbon synthesis on Pd/ZSM5 catalysts. Final report.** Thomson, R.; Wolf, E.E. (Notre Dame Univ., IN (USA). Dept. of Chemical Engineering). 15 Oct 1986. Contract FG22-84PC70788. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001708.

Hydrocarbon synthesis during CO hydrogenation over Pd/M-ZSM5 (M=H,Na,La) and Pd/SiO_2 has been investigated. Overall activity depended on the cation-exchanged form of the support and decreased in the order Pd/La-ZSM5 = Pd/Na-ZSM5 > Pd/H-ZSM5 > Pd/SiO_2. The zeolite-supported catalysts showed high selectivity towards saturated C_2-C_6 hydrocarbons, whereas Pd/SiO_2 favored methanol production. Increasing temperature and H_2/CO feed ratio led to higher reaction rates, lower yields of C_2-C_6 products, and increased lighter hydrocarbons. A mechanical mixture of Pd/SiO_2 and Na-ZSM5 showed similar product distribution as Pd/Na-ZSM5. Infrared spectra of the catalysts under reaction conditions indicate the presence of adsorbed oxygenates on the zeolite. Changes in the IR bands during the initial stages of the reaction suggest that surface species on the zeolite are not methanol synthesis intermediates. The effects of various temperatures and H_2/CO ratios on the spectra are small. The kinetic and infrared results indicate that C_2+ hydrocarbons synthesis over Pd/ZSM5 follows a bifunctional reaction pathway, involving methanol synthesis over Pd and conversion of methanol to hydrocarbons on the zeolite support. 33 refs., 15 figs., 3 tabs.

10721 **(DOE/PC/70812—9) Improved catalysts for coal liquefaction: Quarterly report number 9 for the period September 1, 1986 to November 30, 1986.** Haynes, H.W. Jr.; McCormick, R.L.; King, T.R.; King, J.A. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 31 Dec 1986. Contract FG22-84PC70812. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003812.

Two deactivation runs were completed during the last quarter on catalysts prepared from a magnesia-alumina composite support (TKOl) and a titania-alumina composite support (JKOl). The performance of the TKCl catalyst was poor by comparison to a benchmark run with a commercial catalyst (AMOCAT lA). However, the performance of the JKOl catalyst was roughly comparable to that of the benchmark catalyst. Activities for specific gravity reduction and hydrogen uptake were slightly below same for the AMOCAT catalyst; however, activities for heteroatom removal were slightly higher. Deactivation of the JKOl catalyst paralleled that of the benchmark catalyst. Deactivation of both catalysts were accompanied by losses of pore volume and surface area which could be only partially recovered by regeneration. When the carbon on catalyst was normalized for differences in surface area, there was little difference in deposited carbon on the various supports. 9 refs., 9 figs., 7 tabs.

10722 **(DOE/PC/80012—T6) Biological production of fuels from coal derived gases: Quarterly report, September 20, 1986 to December 20, 1986.** (Arkansas Univ., Fayetteville (USA). Dept. of Chemical Engineering). 1986. Contract AC22-85PC80012. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003447.

A more promising biological approach, perhaps, is the indirect coal conversion of raw synthesis gas by microorganisms capable of producing alcohols, acids, aldehydes, etc. from CO, CO_2, H_2, and H_2O. Therefore, a two step process is required; conventional coal gasification, followed by biological liquefaction. Some of these biological reactions are known to occur, especially those that produce organic acids. Others that produce alcohols from acids or syngases appear promising and possible, but have not been examined. The known reactions use anaerobic organisms and give reasonable rates of reaction. These microorganisms usually produce a single product so that purification systems are simplified. Ordinary temperatures and pressures are used so that substantial capital and energy savings are possible. A cheaper source of synthesis gas can be used, since the problem of sulfur poisoning of catalyst can be eliminated, because sulfur tolerance of microorganisms can often be developed or sulfur can be removed biologically, if necessary. The purpose of this research is to demonstrate the feasibility of producing liquid fuels from the components of synthesis gas through indirect biological liquefaction. Two tasks are to be undertaken in the two year study: (a) a review of biological processes for synthesis gas conversion as shown in the literature, and (b) microbiological screening studies aimed at finding organisms capable of carrying out the conversions, obtained from pure cultures or natural bacterial sources such as sewage sludge, animal wastes, and coal pile mud. 19 refs.

10723 **(DOE/PC/81201—T5) Microbial removal of organic sulfur from coal: Quarterly project status report, September 15 to December 15, 1986.** (Institute of Gas Technology, Chicago, IL (USA)). 15 Dec 1986. Contract AC22-85PC81201. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003451.

The major objective of this project is to develop and improve a microbiological inoculum for the removal of organic sulfur from coal. Model compounds were used in the process of developing cultures with the potential for removing organic sulfur from coal. The use of these compounds has enabled the enrichment of serveral mixed cultures. These cultures have been shown to be able to degrade dibenzothiophene(DBT) and benzothiophene(BT), which are representative of major organic sulfur compounds present in bituminous coal. The first experiments attempted using raw (Illinois No. 6) and deashed coals (Illinois No. 6 and Kentucky No. 9) using certain aerobic mixed cultures enriched for growth in the presence of coal showed no biotic loss of organic sulfur. A modification of the above experiment involved the harvesting of aerobic cultures grown on DBT and BT or both compounds for use as inoculum for coal experiments. Addition of the BT grown culture led to a 35% decrease in sulfide and a 10.9% loss of pyritic sulfur, but no change in organic sulfur. When surfactant was present in addition to the A25 BT grown cells, 21.2% more sulfate was released from the coal than by leaching alone, and 1.4% more of the organic sulfur was lost. The pyritic sulfur loss in DBT grown culture treatments was 15.2%, slightly higher than that observed with the BT grown cultures. In the presence of both DBT grown cells and surfactant, 9.1% more sulfate and 14.9% more pyritic sulfur were lost than in the sterile controls, but only 0.47% more organic sulfur was lost. This is the first time we have detected any loss of organic sulfur over and above losses in sterile leaching controls.

10724 **(DOE/PC/90911—2) Reactivity of heteroatom-containing organics during liquefaction of subbituminous coal: Quarterly technical progress report, July 15-October 15, 1986.** Willson, W.; Knudson, C.; Hawthorne, S. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Dec 1986. Contract FG22-86PC90911. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003432.

Methodology for the direct coupling of coal pyrolysis with GC/MS has been developed and tested and initial results are being evaluated. Several deuterated standard compounds (d_8-carbazole, d_8-dibenzothiopene, d_8-dibenzofuran, and d_6-phenol) necessary for the tubing bomb reaction studies have been synthesized. A reaction vessel has been designed and is being constructed that will allow the large reaction volumes necessary for the production of deuterated anthracene oil solvent. 2 figs., 2 tabs.

10725 **(ERP/ERL—85-58) Carbonization of conventional and partially briquetted charges of a Canadian steel company blend containing western Canadian coals.** Price, J.T.; Gransden, J.F. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1985. 17p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Western Canadian coking coals were investigated to determine potential use in either conventional or partially briquetted

blends used by Canadian steel companies. Carbonization tests were conducted in CANMET's movable wall test oven on two medium volatile western coals using a typical Canadian steel company blend. It was determined that these coals can be readily added to a typical conventionally charged Canadian steel company blend without serious consequences. (7 refs.)

10728 **(EUR—9416-EN) To extend the application of fluidized bed gasification of coal.** (Commission of the European Communities, Luxembourg). 1984. 55p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20057.

This paper discusses the development of fluidized bed gasification for application of the process to the manufacture of industrial fuel gas. Details of experiments carried out are given in brief.

10727 **(EUR—9810-DE) Production of blast furnace coke in horizontal chamber ovens from charge blends of less than standard coking quality by a combination of pre-heating and stamping.** (Commission of the European Communities, Luxembourg). 1986. 72p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20057.

This paper describes a research project designed to produce blast furnace coke by a combination of pre-heating and stamping. Details of the design and operation of the pre- heating system are given along with the advantages it offers. Handling and stamping tests carried out on preheated coal are also reported. Consideration is given to the pilot-scale and full-scale coking test carried out to establish the possibilities offered by pre-heating and stamping compared with wet stamping.

10726 **(EUR—10428-FR) Physical and chemical upgrading of coal and its by-products.** (Commission of the European Communities, Luxembourg). 1986. 37p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20057.

This paper reports on research carried out over a two-year period on the following areas: coal hydroliquefaction; hydrogen pyrolysis; carbonisation and gasification under pressure; mixtures of coal and carboniferous binders. Brief details of the work carried out in these areas are given.

10729 **(EUR—10622-FR) Behaviour of coal during carbonization.** (Commission of the European Communities, Luxembourg). 1986. 32p. (In French). Commission of the European Communities, Luxembourg.

The purpose of this project was to develop a method of detecting oxidation of coal, that could be easily used in a coking plant laboratory not necessarily equipped with sophisticated petrographic and spectrometric facilities. The project also aimed at finding a criterion for quantification of the phenomenon of oxidation. A method was developed based on the fact that oxidation is primarily a surface phenomenon. Successive abrasions of the coal grains followed by screening make it possible to collect the surface 'peel' in the form of fines along with a fraction resulting from fragmentation. If the swelling of these two products is observed as a function of the degree of abrasion, oxidation can be detected. The method of detection can be made faster and suitable for quantitative assessment by addition of pitch. As confirmed by carbonization tests in a pilot-scale oven, the addition of pitch also counteracts oxidation.

10730 **(EUR—10624-DE) Combining the operation of a recuperatively heated coking oven with coal preheating.** Habermehl, D.; Weidenfeller, H.W. (Commission of the European Communities, Luxembourg). 1986. 63p. (In German). Commission of the European Communities, Luxembourg.

This paper describes the operation of two recuperatively heated coking ovens at Bergbau-Forschung GmbH experimental coking plant. An old coke oven design was revived for the heat recuperation process and combined with modern metal heat exchangers. The chief advantage of heat recuperation is that it provided a constant source of heat. The ovens have operated smoothly for five years and the process coupling between recuperative ovens and the precarbon preheating plant caused no problems. Trials with the automatic process-controlled Codeco heating system have shown that process control can produce savings in underfiring energy even with constant heating, and over relatively long coking periods. The advantages of the recuperative oven described in this paper can be summarized as: constant heating, reduction in oven height, precise regulation of individual heating flues, higher power reserves, good combustion index, and low NO/sub x/ emissions.

10731 **(PB—87-105581/XAB) Health-hazard evaluation report HETA 84-284-1701, Granite City Steel, Granite City, Illinois.** Almaguer, D.; Orris, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1986. 21p. (HETA—84-284-1701). NTIS, PC A02/MF A01.

The International Chemical Workers Union requested an evaluation regarding potential employee exposures to a tar-like substance added to incoming coal. Bulk analysis of the material showed benzene/soluble coal tar-pitch volatiles and naphthalene, phenanthrene, fluoranthene, pyrene, ben(a)anthracene, chrysene, benzo(e)pyrene, benzo(a)pyrene, and benz(g,h,i)perylene. Personal air sampling showed that five of eight samples collected for benzene/solubles had concentrations of 88 to 141 micrograms/cubic meter (mg/m^3). The total particulate fraction collected from coal dust in the basement of the pulverizer building contained 1.6% quartz. Respirable coal dust in personal samples ranged from 0.14 to 1.52 mg/m^3. No cases of skin or respiratory cancer were reported among these workers. The authors recommend that coal tar sludge waste product be disposed of according to EPA regulations.

10732 **The Distributed-Energy Chain Model for rapid coal devolatilization kinetics. Part II: Transient weight loss correlations.** Niksa, S. (Sandia National Labs., Livermore, CA 94550). *Combustion and Flame;* **66**: No. 2, 111-120(Nov 1986).

The Distributed-Energy Chain Model (DISCHAIN) is formulated in a companion paper. In this paper, numerical predictions are compared to the transient weight loss from a bituminous coal in vacuum during heatup and throughout isothermal pyrolysis for two heating rates (10/sup 2/, 10/sup 3/K/s) at temperature between 700 and 1300K. Based on seven independent reaction rate parameters, the model predicts transient yields for unreacted coal, gas, tar, and char. Except during heatup at the lower heating rate, the model correlations are in good quantitative agreement with the measured weight loss, and agree with the observed yield enhancement for greater heating rates within the experimental error. This study also includes data correlations from the Distributed Activation Energy Model, to identify the most important model parameters, and model predictions from DISCHAIN for typical pulverized coal combustion conditions, to further illustrate the extent that transient devolatization on short time scales is determined by transient thermal histories.

10733 **The distributed-energy chain model for rapid coal devolatilization kinetics. Part I: Formulation.** Niksa, S.; Kerstein, A.R. (Sandia National Labs., Livermore, CA 94550). *Combustion and Flame;* **66**: No. 2, 95-110(Nov 1986).

The Distributed-Energy Chain Model (DISCHAIN) interprets coal devolatization in terms of independent influences from chemical reaction rates and from macromolecular configuration. Coal is represented by three components: (1) aromatic units that are attached pairwise by (2) labile bridge to form nominally infinite linear chains, with (3) peripheral groups branching from the aromatic units. These components are the building blocks for unreacted coal, free monomers (mobile aromatic units), gas, tar, and char. Four chemical reactions represent bridge dissociation peripheral group elimination, and tar and char formation. Analytic probability expressions and competitive reactions describe the conversion of bound aromatic units into free monomers, and enter into the formation of all products except gas. There are no hypothetical ultimate yields. The model is introduced in two parts. Here in Part I, the coal model, chemical reactions, and chain statistics are derived and formulated into rate equations. Mechanisms leading to major products are identified, including a novel mechanism for yield enhancement by faster heating. Whenever bridge dissociation and char formation occur concurrently, as for slow heating, the subsequent generation of monomers is inhibited. Aromatic units are thereby excluded from the competition between tar and char formation. Con-

versely, bridge dissociation and char formation occur consecutively for rapid heating, and a greater proportion of the original bound aromatic units become monomers and, ultimately, tar.

10734 **Spectrophotometric determination of iron in process samples from the chemical cleaning of coal.** Chriswell, C.D.; Richardson, R.G.; Markuszewski, R. (Iowa State University, Ames, IA (USA). Ames Laboratory, USDOE). *Talanta;* **33**: No. 8, 700-702(Aug 1986).

Iron is removed during the desulphurization and demineralization of coal by a chemical cleaning process utilizing a mixture of molten sodium hydroxide and potassium hydroxide. When 1,10-phenanthroline is used for spectrophotometric determination of the iron in the various caustic, aqueous and acidic process streams, organic materials leached from the coal by the molten caustic interfere with the colour-forming reaction. Pre-oxidation of the samples with potassium persulphate has proved to be an effective means of removing the interfering organic material before the iron determination. 14 refs.

10735 **Measurement of alkali vapor in PFBC flue gas and its control by a fixed granular bed of activated bauxite.** Lee, S.H.D.; Myles, K.M. (Argonne National Laboratory, IL (USA)). pp 149-166 of Gas cleaning at high temperatures. Rugby, England; Institution of Chemical Engineers (1986). (CONF-860940—).

From Gas cleaning at high temperatures conference; Guildford, Surrey, UK (16 Sep 1986).

A fixed granular-bed sorber is being developed at Argonne National Laboratory for the control of the alkali vapor in the HTHP PFBC flue gas. Discusses laboratory studies of the high-temperature/high pressure sorption characteristics of activated bauxite including the following; experimental details, the effect of flue gas without NaCl vapor on activated bauxite, the effect of flue gas with NaCl vapor on activated bauxite, sorption mechanisms and the reentrance of alkali to flue gas. Also discusses the laboratory-scale demonstration of a fixed granular-bed activated bauxite sorber for control of alkali vapor in PFBC flue gas, including the ANL pressurized fluidized-bed combustor/alkali sorber system, initial testing of the PFBC/alkali sorber system, alkali vapor concentration measured by Ames alkali analyzer, alkali vapor concentration measured by batch-type APST and analysis of the alkali in the ash. 32 refs.

10736 **Evaluation of three high-temperature particle control devices for coal gasification.** Dellefield, R.J.; Bedick, R.C. (USDOE Morgantown Energy Technology Center, WV (USA)). pp 467-482 of Gas cleaning at high temperatures. Rugby, England; Institution of Chemical Engineers (1986). (CONF-860940—).

From Gas cleaning at high temperatures conference; Guildford, Surrey, UK (16 Sep 1986).

The U.S. Department of Energy is evaluating three particulate control devices for high temperature and high pressure gasifier electricity generating systems. Bench-scale tests are being conducted to evaluate a Ceramic Cross-Flow Filter, an Electrostatic Precipitator, and a Ceramic Bag Filter using a Fluidized Bed Coal Gasifier. The paper discusses the test facility and initial results. Tests have shown the Cross-Flow Filter and the Ceramic Bag Filter showed 98 to 99 percent and 90 to 99 percent collection efficiencies respectively. The Electrostatic Precipitator has undergone initial voltage and current measurements at elevated temperatures and pressures. 11 refs.

10737 **An overview of the US DOE Coal Gasification Program.** Halow, J.S. (US Dept. of Energy, Morgantown Energy Technology Center, P.O. Box 880, Morgantown, WV 26505-0880). pp 170-175 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The US Department of Energy is currently sponsoring a variety of projects aimed at developing advanced systems which use gasification as the primary conversion process. These systems include ones for electric power generation, synthesis gas, and industrial fuel gas. This paper discusses the approach that has been used for determining R & D areas and the status of some major projects in the gasification program.

10738 **High-pressure operation of a fluidized-bed ash-agglomerating gasifier.** Patel, J.G.; Sandstrom, W.A. (Institute of Gas Technology, Chicago, IL 60616). pp 180-185 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

A coal test program in a pressurized, fluidized-bed, ash-agglomerating process development unit was conducted at the Institute of Gas Technology under the sponsorship of the Gas Research Institute. The overall objective of this test program was to obtain a data base on fluidized-bed ash-agglomerating gasification with United States coals at elevated pressures of up to 300 psig. Three U.S. coals - an Eastern bituminous, a Western subbituminous, and a lignite - were tested in this program. The test program has provided valuable information on the effects of pressure on ash-agglomerating fluidized-bed gasification of U.S. coals.

10739 **Erosion-corrosion mechanisms and rates in Fe - Cr steels.** Levy, A.V.; Man, Y.F. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 16 of Proceedings of the technical symposium of Corrosion 86. Houston, TX; National Association of Corrosion Engineers (1986). (CONF-860304—). Contract AC03-76SF00098.

From Corrosion '86; Houston, TX, USA (17 Mar 1986).

Erosion-corrosion behavior of chromium containing steels was determined. The steels tested are used in coal gasifiers and fluidized bed combustors. A change in scale loss mechanism occurred between 5Cr and 9Cr steels with the higher chromium steels having lower metal loss rate than 2 1/4 and 5Cr steels. The composition of the scales was not as important as their morphology and thickness in determining metal loss rates.

10740 **The flash hydropyrolysis and methanolysis of coal with hydrogen and methane.** Steinberg, M. (Process Sciences Div., Dept. of Applied Science, Brookhaven National Lab., Upton, NY 11973). pp 257-286 of Hydrogen systems. Veziroglu, T.N.; Zhu, Y.; Bao, D. Elmsford, NY; Pergamon Press (1985). (CONF-850512—).

From Beijing international symposium on hydrogen systems; Beijing, China (7 May 1985).

The process of flash pyrolysis consists of rapidly heating a carbonaceous material to elevated temperatures (≧ 10/sup 4/°C/sec usually to temperatures above 700°C) with either a reactive or nonreactive gas, allowing reaction to take place at elevated temperature for short periods of time (≦ 10 sec) and quickly cooling (≧ 10/sup 2/°C/sec) the reaction system to terminate the reaction. The carbonaceous material is depolymerized into short chain and smaller light molecules which can, at the elevated temperature, react with each other or react with the pyrolyzing gas, and upon fast cooling, the lighter products are stabilized preventing repolymerization and char formation. When hydrogen is used as the pyrolyzing gas, the process is referred to as flash hydropyrolysis (FHP). When methane is used, the reaction is referred to as flash methanolysis (FM). The process can also be extended to steam, which is then referred to as flash hydrolysis.

10741 **(BG-Trans—14994) Chloride induced corrosion in the generation and processing of gas produced from hard coal by the Lurgi high pressure gasification process.** Bieger, F.; Krueger, G. Translated from *Werkstoffe und Korrosion ;* **3**: 224-230(1966). 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900421.

This paper reports on the corrosion encountered in high pressure gasification and the countermeasures taken since 1955 by the operational staff of the plant to eliminate and prevent this type of damage. Corrosion occurred not just in the gas generators of the plant but also in the tar distillation, ammonium sulphate and petrol refinery units. Since the damage arising in these plants was caused

in all cases by chlorine, these corrosion phenomena are also included in this paper. In order to describe the corrosion observed in the gas generator the investigator first briefly outlines the gasification process and the apparatus used for coal gasification. 6 refs., 15 figs.

0106 Properties

REFER ALSO TO CITATION(S) 10697, 10701, 10705, 10727, 10729, 10734, 10802, 10803, 10805, 10809, 11118, 11755, 11757, 11772, 11819

10742 (ARL-TR—53) Production of stable and pumpable coal-water slurry fuels. Al Taweel, A.M.; Fadaly, O. (National Research Council of Canada, Ottawa, Ontario). 1985. 71p. (NRCC—24797). National Research Council of Canada, Ottawa, Ontario.

This project was undertaken in an attempt to develop a better understanding of the factors affecting coal water mixtures (CWM) characteristics. The rheology and stability of CWM were found to be highly dependent on the structure (or aggregates) formed within the slurries. This in turn is dictated by the forces of interaction between the coal particles, which are strongly influenced by the rank and surface characteristics of the coal. Attention was focussed on the testing and evaluation of additives suitable for maritime coals. 94 refs.

10743 (DOE/PC/70809—T12) Microbial screening test for lignite degradation: Quarterly progress report No. 8 for the period October/December 1986. Yen, T.F. (University of Southern California, Los Angeles (USA)). 1986. Contract FG22-84PC70809. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003443.

The metal sodium-methanol modification process of raw lignite has been further studied by elemental analysis and scanning electron microscopy equipped with energy dispersive system (SEM-EDS). The former provides information to construct lignite structure. The latter gives ash composition to trace the fate of metal sodium. Quantitative data of intermediates and products are also reported. Bioliquefaction of lignite was attempted by white rot fungi S-1. Liquid chromatography was utilized to detect the presence of phenolic compounds in the liquid product derived from surface culture method. A non-continuous bioreactor system was used to degrade lignite. In a simple fixed-bed system, the concentration of phenolic compound in the resulting leachate was found to increase as process proceeded. It is believed that the degradability of lignite can be enhanced by the incorporation of hydroxyl group into lignite's macromolecular structure. Hydroxylation has been currently investigated. Based on the results of our preliminary experiment, it was found that Fenton's reagent is effective for hydroxylating lignite. Direct evidence to quantify the incorporation of hydroxyl group into the structure of lignite has not been proved yet. However, indirect evidences such as the increase of hydrophilicity and the release of small amount of phenol showed that hydroxylation did occur as lignite reacted with Fenton's Reagent. 11 refs., 12 figs., 5 tabs.

10744 (DOE/PC/80517—T5) Improving the stability of coal slurries: Quarterly progress report for the period Sep. 15, 1986-Dec. 15, 1986. Fogler, H.S. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). 1986. Contract FG22-85PC80517. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003390.

The last quarterly progress report focused on the adsorption study of the polystyrene latex spheres with gum tragacanth (GT), and the adsorption mechanism was found to be hydrophobic rather than electrostatic. Also, the effect of the amount of GT adsorbed, the bulk concentration of GT, incubation time and pH on the stability factor was examined, and the results indicated that the conformation of GT on the surface of latex spheres plays an important role in the stabilization. This report presents the results of the coal-water slurries, mainly focusing on the adsorption study of GT by changing pH and ionic strength. It was found from the experiment in which the ionic strength was changed that the adsorption of GT on the coal particles is hindered by the coulombic repulsion between GT and coal. In addition, the experiment in which pH was changed also indicated that the adsorption mechanism is electrostatic in nature. 7 refs., 2 figs.

10745 (DOE/PC/80522—T2) Metal arene complexes in coal structure determination: Quarterly report for the period, September 1986-November 1986. Woolsey, N.F. (North Dakota Univ., Grand Forks (USA). Dept. of Chemistry). Dec 1986. Contract FG22-85PC80522. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003437.

Continued investigation of arene metal (Cr, Fe) complexes for methods of α-alkyl group cleavage has shown several advances during this quarter. Peroxide oxidation of an arenetricarbonylchromium complex anion has given preliminary evidence for phenol formation by methyl group removal. An arene iron complex anion was shown to react by 1,3-dipolar cycloaddition but did not show cleavage of an alkyl group from the arene ring. A postulated rhodium complex sequence where metal insertion into a carbonyl α bond provides a formal method to achieve the objectives of the proposed research when taken in conjunction with α-oxidation of arene metal complex anions. All of these reactions or procedures are in their preliminary stages at present but look very promising. 2 refs.

10746 (DOE/PC/90502—1) Catalyst accessibility in high volatile bituminous coal: Quarterly report. Kispert, L.D. (Alabama Univ., University (USA). Dept. of Chemistry). Jan 1987. Contract FG22-86PC90502. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004012.

The general objective of this research is to determine catalyst accessibility and the possible formation of hydrogen bonds in swellable pores of bituminous coal samples after the samples have been subjected to swelling by appropriate solvents, temperature variation and extraction with various acids or bases. To achieve this goal, use is being made of an EPR technique that has been developed recently in this lab involving nitroxide spin probes of different size, shapes and containing substituents with sites for hydrogen bonding. It has been shown possible to incorporate these nitroxide spin probes in the swellable pores of high volatile bituminous (hvb) Alabama coal from the Mary Lee, Black Creek, and American seams, as well as in samples of hvb coal from the Illinois No. 5 seam. Once the spin probes have become trapped in the swellable pores by pumping off the swelling solvent, it is possible to examine the accessible areas of a given size for a particular coal sample. It is also possible to detect in these accessible areas, the presence of hydrogen bonding as a function of swelling solvent, size of the diffusing spin probes, and temperature. It appears possible to estimate the size and number distribution of coal pores with or without hydrogen bonding sites, acidic or basic sites or reactive free radical sites.

10747 (DOE/PC/90960—2) Rheology of high concentration polymodal multiphase flows: Quarterly report. Probstein, R.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Jan 1987. Contract FG22-86PC90960. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003861.

In the first quarterly report a major problem encountered in characterizing dense coal slurry experiments was discussed, namely, the difficulty of experimentally determining in advance specified solid volume concentrations. A procedure was presented there that was devised for making such determinations experimentally. We first summarize the approach, following which experiments using the technique are presented.

10748 (ERP/CRL—86-50(J,OP)) A δP technique for the prediction and monitoring of coal oxidation. Mikula, R.J.; Michail, M.W. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Apr 1986. 23p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

The effect of oxidation on coal properties important in beneficiation and utilization was examined. The chemical changes taking place during oxidation were monitored by measuring the rate and amount of gas desorption from the coal sample. Comparisons were also made with naturally weathered coal samples. It is expected the results of such tests might be used to predict the weathering propensity of a coal before it is stockpiled. Although the δP technique is not useful as an absolute measurement of coal oxidation, it presents a simple method for monitoring the progress of oxidation. 15 refs.

10749 **(ERP/CRL—86-71(TR)) Mineralogical composition of respirable coal dust.** Hwang, C.Y. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Jun 1986. 8p. Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.

This project was undertaken in an effort to improve the understanding and the control of respirable dusts in underground coal mines. Analytical work was conducted to determine the true weight percentages of the major minerals found in airborne dust collection filters during field personnel sampling and fixed location sampling. Techniques used to prepare specimens and transfer the dust samples from filters to specimen holders are described. X-ray diffraction speedometry and scanning electron and scanning transmission electron micro-analysis are analytical methods examined. 3 refs.

10750 **(EUR—10625-EN) Optimization of the texture of carbon in coke.** Patrick, J.W. (Commission of the European Communities, Luxembourg). 1986. 80p. Commission of the European Communities, Luxembourg.

The objectives of this research were to investigate whether modification of the texture of cokes from lower rank coals towards that of cokes from prime-coking coals could improve coke quality. Three approaches were adopted: the tensile breakage of coke and the influence thereon of the coke textural components was studied by examining in an SEM, specimens loaded to different extents; attempts were made to statistically relate quality parameters of coke with their textural composition; and finally additions of pitches to low-rank coals prior to carbonization were studied to investigate whether such additions enhanced the carbon texture and improved the coke strength.

10751 (ORNL—6261, pp 4-23) **Coal chemistry.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

The goal of this fundamental research program on the organic chemistry of coal is an improved knowledge of the structure and reactivity of this complex material. A new internal standard procedure to measure the fraction of coal carbon detected by CP/MAS-^{13}C-NMR is described in 2.1 along with quantitative measurements of this fraction for a few coals of differing rank and a few chemically modified coals. Section 2.2 presents initial results concerning the regiospecificity of a ^{1}H-^{31}P-^{13}C-DCP/MAS-^{13}C-NMR technique, which has been gained from model compound studies. Recent developments in the application of strong base chemistry to the investigation of acidic C-H and O-H sites in coals are described in 2.3 and 2.4 including a new controlled pH methodology for studying the distribution of O-H sites in coal with pK/sub a/ $\leqq$ 12. The transalkylation reaction has been used to probe the aliphatic structure of several coal products and derivatives (2.5), and model compound studies have clarified the origin of some unexpected products. Section 2.6 highlights the major effects of surface immobiliation on altering the thermal reaction pathways for bibenzyl and presents initial results on the thermolysis of surface immobilized 1,3-diphenylpropane.

10752 **Separation and characterization of hydroxyl aromatic in complex fractions from nondistillable coal-derived liquids.** Cooper, H.A.; Hurtubise, R.J.; Silver, H.F. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* **58**: No. 14, 3011-3016(Dec 1986). Contract AC22-83PC60015.

Complex hydroxyl aromatic fractions isolated from nondistillable coal-derived liquids were separated by a combination of normal-phase and reversed-phase liquid chromatography. The normal-phase chromatographic step effected the separation of hydroxyl aromatics into mono- and dihydroxyl fractions. The mono- and dihydroxyl fractions from the coal-liquid sample were characterized with infrared and field-ionization mass spectrometry (FIMS). A monohydroxyl fraction of oils from a Kentucky coal-liquid sample was separated with an optimized reversed-phase chromatographic system. The monohydroxyl fraction was completely eluted by using a combination of isocratic and gradient elution conditions. The combination of reversed-phase liquid chromatography and FIMS provided a unique method for the characterization of the monohydroxyl fraction of oils from the Kentucky coal-liquid sample.

10753 **Isolation and identification of mutagenic polycyclic aromatic hydrocarbons from a coal gasifier condensate.** Haugen, D.A.; Stamoudis, V.C. (Argonne National Lab., IL). *Environmental Research;* **41**: No. 2, 400-419(Dec 1986). Contract W-31-109-ENG-38.

An iterative scheme of short-term bacterial mutagenesis assays and multidimensional liquid chromatographic methods was used to isolate mutagens from a neutral fraction of a complex carcinogenic tar formed as a by-product of coal gasification. Mutagens in the complementary reversed- and normal-phase liquid chromatographic fractions were identified by capillary column gas chromatography and gas chromatography-mass spectrometry. The principal mutagens included a variety of 4- to 6-ring unsubstituted polycyclic aromatic hydrocarbons, their alkylated homologs, and related methylene-bridged compounds. Most of the unsubstituted mutagens were known carcinogens that were qualitatively similar to those detected by carcinogenicity assays of fractions from other types of coal tars and cigarette smoke condensate. The chromatographic approach is generally applicable to complex mixtures and is especially well suited for fractionating mixtures of aromatic compounds and their alkyl homologs.

10754 **Some thoughts on the sampling process and process sampling.** Schultz, H. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp 1024 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—).

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

Sampling is the critical first step in performing chemical analyses and as such should be the subject of more careful thought and planning than it often gets. The planning should be conducted in concert with the engineers or scientists who are interested in the chemical or physical characterization of the sample. This discussion uses case studies involving coal, the products of coal conversion, and related materials such as catalyst pellets. These materials are heterogeneous and difficult to sample so that any observations made concerning their sampling should have general applicability. Examples are given of planning, and representative and non-representative sampling.

10755 **Practical concepts in the documentation of analytical methods.** Wells, A.W.; Gibbon, G.A.; Retcofsky, H.L. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp 886 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—).

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

This paper presents useful concepts of organization and formatting in the documentation of analytical methods. Principles of technical writing are discussed and applied to recording analytical methods for manuals, laboratory files, and journals. Emphasis is on the overall design of an analytical methods manual based upon the experience gained in writing a multivolume manual that will document a wide range of analytical procedures used in coal science. Also discussed are the utility of the document as an aid to quality assurance and reproducing experimental techniques. This manual is to be published by the United States Department of Energy at the Pittsburgh Energy Technology Center (PETC). At the Pittsburgh Energy Technology Center, emphasis is placed upon long-term, high-risk research and fundamental knowledge in many areas of coal science. This mission results in constantly changing requirements, and highly adaptable methods are used. The manual is written to function as an in-house reference and training aid and at the same time to clearly communicate our experiences to non-PETC coal researchers. Some adaptations and clear definitions of terminology were necessary to fulfill these two major objectives. The

unique chemical and physical properties of many samples encountered at PETC required the description of specialized techniques in sampling, homogenizing, safety, and sample handling during analysis. The accurate documentation and updating of analytical methods in a clearly stated manner is an important quality assurance objective for any analytical service or research organization. The ideas presented can be of value to anyone seeking to communicate experimental information, as well as to the writer of method manuals.

10756 **The determination of low level sulfur in coal and related materials by turbidimetry.** Rohrer, R.L.; Schultz, H. (U.S. Dept. of Energy, Div. of Coal Science, Pittsburgh, PA 15236). pp 198 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—).

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

At the present time there are no methods in the literature for the determination of small (i.e., <0.1%) quantities of sulfur in chemically cleaned coals and related materials with a high degree of precision, reliability, and simplicity of technique. An analytical method for this purpose has been developed at PETC. This method involves the formation of a suspension of barium sulfate and the measurement of the turbidity of the resulting solution.

0108 Waste Management

REFER ALSO TO CITATION(S) 10735, 10803, 10806, 10807, 10808, 10810, 10811, 10813, 10814, 11181, 11182, 11183, 11184, 11185, 11186, 11187, 11188, 11189, 11190, 11906, 12245

10757 **(DOE/PC/80512—T7) Anaerobic SBR [Sequencing Batch Reactor] treatment of coal conversion wastewaters: Fifth quarterly report.** Ketchum, L.H. Jr. (Notre Dame Univ., IN (USA). Dept. of Civil Engineering). 23 Dec 1986. Contract FG22-85PC80512. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003454.

Work continues to develop an operating strategy and a basis of design for Anaerobic Sequencing Batch Reactor (AnSBR) biological treatment of coal conversion wastewaters. The laboratory studies use three different size reactors: 150-mL serum bottles to screen individual coal conversion wastewater constituents; six 2-L AnSBR's to acclimate anaerobic sludges (i.e., organisms) to mixtures of these constituents; and, two automatically operated. 4-L AnSBR to treat a synthetic coal conversion wastewater currently consisting of phenol, plus vitamins and minerals. During this reporting period phenol was degraded after 60 days; catechnol was degraded after 90 days in initial concentration of 1000 mg/L. Aniline and 5 different xylenols were not degraded after 120 days at above conditions; same for three different trimethylphenols.

10758 **(DOE/PC/81008—T5) Direct sorbent injection for combined SO_2/NO/sub x/ removal: Quarterly technical progress report, July-September 1986.** Dowdy, T.E.; Henry, J.M.; Lee, J.J.; Byrd, S.I. (Tennessee Univ., Tullahoma (USA). Space Inst.). 1986. Contract AC22-85PC81008. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87002831.

This project has as its objective the experimental verification of a low cost system for simultaneous SO_2 and NO/sub x/ control technology. The system selected will be configured to require minimum capital cost and minimum additional space. SO_2 and NO/sub x/ reduction to the maximum degree that is economically attractive is sought. The approach taken is to inject active SO_2 and NO/sub x/ sorbents into a flue gas stream that simulates flue gases from a large scale coal fired boiler. The project will also include mathematical modeling to reduce the data and to extend the results to larger systems. During the July through September, 1986 quarter tests were conducted in Series D - Spray Droplet Drying Rate Test Studies and the laser velocimeter tests were completed. Results of these tests are presented in this report. The modeling work was expanded to include the slurry spray droplets in the flow calculations.

10759 **(DOE/PC/90753—T2) Coal ash deposition, interaction with metal substrates and deposit build up: Second quarterly report, Sept. 24-Nov. 25, 1986.** Birks, N. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 8 Dec 1986. Contract FG22-86PC90753. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003371.

Preliminary experiments established the techniques for preparation and analysis of specimens. It has also been established that the use of synthetic ash mixtures may lead to misleading results.

10760 **(ECN—85-184) Environmental aspects of the utilization of pellets prepared from phosphogypsum, coal fly ash and cement.** Van der Sloot, H.A.; De Groot, A.J. (Netherlands Energy Research Foundation, Petten). Dec 1985. 5p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Phosphogypsum is a residue of the phosphate fertilizer industry. In order to find solutions for the current yearly discharge of 2x10/sup 6/ tons of phosphogypsum in surface waters, studies were started to evaluate the technical, economical and environmental aspects of the preparation of pellets from phosphogypsum, coal fly ash and cement. This contribution deals with the environmental aspects of this operation. The study has shown that the release of Cd, Cu and Zn from these pellets is substantially reduced in comparison with phosphogypsum. SO/sub 4//sup 2-/, F and Mo release on the other hand limit to a certain extent their application. Appropriate fields of utilization from an environmental point of view are embankment and structural fill. 10 refs.

10761 **(EPRI-CS—3342-Vol.5) Economic evaluation of FGD systems: Volume 5, The NOXSO and SOXAL sodium-based processes and four additional calcium-based processes: Final report.** Keeth, R.J.; Krajewski, M.J.; Ireland, P.A. (Stearns Catalytic Corp., Denver, CO (USA)). Oct 1986. 421p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920101.

This volume presents the estimated costs for the NOXSO, High Sulfur Lime Spray Dryer, Saarberg-Holter/Limestone, SOXAL, Organic Acid Enhanced Limestone and Limestone with Wallboard Gypsum By-Product FGD systems based on December 1982 dollars and 1985 technology. These systems were evaluated for operability, technical merit, and commercial availability. Each FGD system was evaluated for a high sulfur coal application at a new, hypothetical 1000 MW (two 500 MW units) power plant located in Kenosha, WI. This arbitrary reference plant was selected to ensure consistent comparisons, and to increase the relative accuracy of the costs presented. The evaluation methods employed in this study were identical to those used in previous EPRI volumes of the report, CS-3342, "Economic Evaluation of FGD Systems." A flow sheet, material balance, equipment list, system description, and utility consumption list form the basis of each FGD process evaluation. Cost information was obtained from process vendors, the Stearns Catalytic data base, and published reports. Capital costs were estimated by factoring costs of process equipment (i.e., an EPRI Class II estimate). Operating costs were estimated from reagent and utility consumption. The levelized capital and operating costs were developed using EPRI's standard economic premises. Costs have an absolute accuracy of +-30%. However, since methodology, scope, and unit costs are consistent, the relative accuracy between process estimates probably is +-15%. 88 figs., 64 tabs.

10762 **Biological nitrification and hydantoin removal in coal gasification wastewater.** Turner, C.D.; Diepolder, P.; Strain, J. (University of North Dakota Energy Research Center, Grand Forks, ND (USA)). pp 43-51 of Proceedings of the 40th industrial waste conference. Stoneham, MA; Butterworth Publishers (1985). (CONF-8505160—).

From 40. annual Purdue industrial waste conference; West Lafayette, IN, USA (14 May 1985).

With a completely mixed continuous-flow reactor and addition of powdered activated carbon, hydantoins were oxidised only after complete nitrification had occurred. 6 refs.

10763 **Flue-gas-cleanup research at Pittsburgh Energy Technology Center.** Yeh, J.T.; Demski, J.; Gyorke, D.P.; Joubert, J.I. (Pittsburgh Energy Technology Center, PA (USA)). pp IV/1-IV/18 of Fluidized bed combustion and applied technology - the first international symposium. Schwieger, R.G. (ed.). New York, NY; Hemisphere Publishing Corp. (1984). (CONF-830824—).

From 1. international fluidized bed combustion and applied technology symposium; Beijing, China (22 Aug 1983).

Also published by McGraw-Hill Publications Co., New York, NY, USA.

Three advanced flue gas cleanup processes have been investigated: dry sorbent injection for SO_x removal; spray dryer injection for SO_2 removal; and a fluidized-bed copper oxide process for simultaneous SO_2/NO/sub x/ removal. This paper summarizes experimental results obtained in evaluating these approaches for potential use in facilities burning Eastern US coals. Tests were conducted using an experimental furnace designed to burn 500 lb/hr of pulverized coal. In the dry sorbent injection tests, sorbents were injected into the furnace flue gas as a dry powder, upstream of a baghouse filter. The spray dryer SO_2 removal study was conducted using slurries of lime, limestone, magnesium oxide, and lignite fly ash. In tests of the fluidized-bed copper oxide process, copper-impregnated alumina spheres were used as the SO_2 sorbent. Removal of NO/sub x/ was achieved by selective catalytic reduction when NH_3 was injected into the flue gas upstream of the fluidized bed. All three processes can achieve 90% SO_2 removal from flue gas. The copper oxide process can simultaneously remove 90% of the NO/sub x/. 14 refs., 15 figs., 1 tab.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 10798, 10802

10764 **(DOE/FE/60339—T42) Modeling for economic and policy analysis of strategies to reduce coal sulfur emissions: Final report, July 1, 1985-February 28, 1986.** Arey, D.; Cornwall, E.; Dziegielewski, B.; Crenshaw, J.; Parker, G.; Drylis, I. (Southern Illinois Univ., Carbondale (USA)). May 1986. Contract FC22-83FE60339. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002794.

A new version of the Coal Supply and Transportation Model (CSTM) is presently operational at the SIUC Coal Technology Laboratory (CTL). This model has been updated and improved over the last three years. The resultant model (CTL/CSTM) permits the forecasting of SO_2 emissions resulting from coal combustion under a variety of scenarios. During the eight-month period covered by this report, the efforts of the CTL/CSTM Research Team focused on two general problems. First, the model was further examined for improvement and modification, and second, the model was used to analyze new developments in the coal market and in the technology relating to coal combustion. A separate task was undertaken in an effort to test the validity of the model by comparing CTL/CSTM 1985 forecasts with actual coal production and consumption statistics for recent years. Finally, as a mechanism to disseminate information about the existence and potential uses of CTL/CSTM, a modeling workshop was held in late February in Springfield, Illinois. 13 refs.

10765 **(ERP/CRL—86-39(OP,J)) Computer analysis of the effects of mine subsidence on pipelines.** Hucka, V.J.; Tu, H.J.; Das, B. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Mar 1986. 18p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

A computer program was developed which can determine the components of surface subsidence in any particular direction on the surface to calculate the strains on a pipeline crossing a subsided area. Surface subsidence can cause serious damage to surface facilities such as railroads, highways, buildings and pipelines. Subsidence-induced strains on a pipeline over some coal mining properties in Utah were analyzed using the computer program. Results of a comparison between predicted strain and permissible strain indicated that the pipeline would be damaged if a program of full extraction was carried out. 3 refs.

10766 **(PB—87-100350/XAB) Western surface mine permitting and reclamation.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jun 1986. 304p. (OTA-E—279). NTIS, PC A14/MF A01.

This report examines the role and effectiveness of lease stipulations and permit conditions as means of imposing technological or methodological requirements for environmental protection and resolving uncertainties in mining and reclamation situations. It includes technical and policy options for successful reclamation of Western lands.

10767 **(PML—1984-C-38) Tracer aerosol generator: feasibility study. Part 2: Final report.** Oeseburg, F. (Prins Maurits Lab. TNO, Rijswijk (Netherlands)). 1984. 76p. (In Dutch). Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands.

A selection of commercial available monodisperse aerosol generators with source strengths comparable with the required source strengths mentioned in Reference 4 was made (projects: Sampling efficiency of instruments for the measurement of particulate matter (OWS-2.1); Validation of models for the atmospheric dispersion of coal dust using tracer aerosols (TVS). Suitable tracers were selected taking into account the critical relative humidity and the solubility of the compound, the concentration of the background aerosol, the blank of the filter material, the detection limit of the method of analysis (AAS) and the toxicity (TWA-value). The feasibility of the technical concept, including the generation of a primary spray consisting of a solution of the tracer in water and the subsequent evaporation of the spray, was studied for both projects (OWS-2.1; TVS) by means of the theoretical analysis. An evaporation model was developed for this purpose. Moreover an estimate of the required power was made and this estimate was compared with a previously fixed limit. A concise description of the methods of analysis of the tracer-aerosol (mass concentration; particle size) was given.

10768 **(PML—1984-C83) Development of a tracer aerosol generator. Part 1: Particle size distribution of sprays, generated with the micro-ulva.** Oeseburg, F. (Prins Maurits Lab. TNO, Rijswijk (Netherlands)). Jul 1984. 30p. (In Dutch). Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands.

An aerosol generator for the generation of monodisperse solid aerosols is being constructed within the framework of the programme 'Fugitive Dust'. This device will be used in experiments to determine the sampling efficiency of a number of samplers for solid aerosols. Sprays consisting of a solution of the solid tracer in water are generated by means of a spinning disk (Micro-Ulva) which is an important component of the tracer aerosol generator. The solid aerosol is created after evaporation of the water. Particle size distributions of water sprays generated by means of the Micro-Ulva were measured. Sampling was carried out with the aid of impaction rods which were drawn manually through the spray. The rods were provided with a layer of magnesium oxide in order to achieve fixation during sampling. The analysis was carried out using a microscope. The 'true' diameters of the particles were calculated using the spreading factor (0.85) reported by May. Volume particle size distributions were calculated starting from the measured number size distributions. Relevant parameters (mode, relative standard deviation) of the distributions of both the regular particles and the satellites were estimated. The relative standard deviation of the distributions of the regular particles were compared with the required value following from the feasibility study. It was concluded that the Micro-Ulva is an appropriate atomizer for the tracer aerosol generator.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 10776

10769 (DOE/FE/60177—2250) Survey of tar sand deposits, heavy oil fields, and shallow light oil fields of the United States for underground coal gasification applications. Trudell, L.G. (Western Research Inst., Laramie, WY (USA)). Jun 1986. Contract FC21-83FE60177. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004289.

A literature survey was conducted to identify areas of the United States where tar sand deposits, heavy oil fields, or shallow light oil fields might be suitably associated with coal deposits for production of oil by in situ thermal recovery methods using heat derived from underground coal gasification (UCG) processes. The survey is part of a Department of Energy-sponsored program to develop new applications for UCG technology in utilizing coal resources that are unattractive for mining. Results from the survey indicate tar sand deposits, heavy oil fields, or light oil fields are probably or possibly located within 5 miles of suitable coal in 17 states (Table 1). Especially promising areas are in the Uinta Basin of Utah; the North Slope of Alaska; the San Miguel deposit in southwest Texas; the Illinois-Eastern Interior Basin area of western Kentucky, southwestern Indiana and Illinois; the tri-state area of Missouri, Kansas and Oklahoma; and the northern Appalachian Basin in eastern Ohio and northwestern Pennsylvania. The deposits in these areas warrant further evaluation. 30 refs., 4 figs., 1 tab.

10770 (DOE/MC/03193—2211) An evaluation of the effect of methane adsorption/desorption in well tests on coal beds: Final technical report. Bayles, G.A.; Reznik, A.A. (Pittsburgh Univ., PA (USA)). Sep 1986. Contract AH21-85MC03193. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001024.

Transient and semi-steady-state solutions of the radial diffusivity equation are presented for the case of well tests on coalbed-methane reservoirs. An inverse diffusion term, which characterizes coupled matrix-fracture gas transport, is defined from a Langmuir desorption term and the inverse hydraulic diffusivity. The ratio of this total or coupled diffusivity to the hydraulic diffusivity is identified as the time delay of the bottom-hole flowing pressure response of the coalbed vis-a-vis that of a conventional gas reservoir during a constant-rate pressure drawdown test. The modified transient and semi-steady-state equations for pressure drawdown as functions of time are completely analogous to those for conventional gas reservoirs when the inverse hydraulic diffusivity of the latter is replaced by the inverse coupled diffusivity of the coalbed. A numerical simulator is employed to solve the open forms of both the conventional and coalbed radial diffusivity equations. The usual straight-line trends for the transient and semi-steady-state periods are manifest from simulations of both cases. These were parallel for the transient time period and divergent for the semi-steady-state period. Values of permeability, net skin factor, area of drainage and shape factor are obtained directly from the pressure-versus-time plots of the two time periods. The present analysis is limited to the extreme matrix-to-fracture transport rates, namely, instantaneous and zero. Actual pressure-response data, however, can be analyzed and the actual matrix-to-fracture transport rate can be determined analytically. The present work is limited to single-phase gas flow without wellbore storage and to a single net skin effect. 12 refs., 7 figs., 64 tabs.

10771 (DOE/PC/91404—T2) Research needs and data acquisition to apply US technology to foreign coals: Quarterly report, October-December 1986. (Viking Systems International, Pittsburgh, PA (USA)). 1986. Contract AC22-86PC91404. 49p. NTIS, PC A03. File Number DE87004138.

The National Coal Technology Data Center (NCTDC) at the Pittsburgh Energy Technology Center is currently addressing the recognized need for technical and scientific information on international coal characteristics and coal conversion technologies adopted in foreign countries. At NCTDC, the present database on domestic coals and coal conversion technologies is being supplemented with data on international coals through the development of a comprehensive international database on foreign coals and coal conversion technologies. DOE plans to utilize this information to develop strategic planning and policy options and assist the private sector in determining the utility of its products and services in the international market place. It is hoped, that through the better understanding of their foreign coal resources, advanced US coal preparation, conversion and utilization technologies can be applied to these coals, promoting not only US technology transfer but also addressing the immediate energy needs of the developing countries.

0120 Mining

REFER ALSO TO CITATION(S) 10771, 10833, 10881

10772 (ACIRL-PR—86-1) Development and use of a gas outburst reporting form and database for outburst-prone collieries. Shepherd, J.; Rixon, L.K.; Pauncz, I. (Australian Coal Industry Research Labs. Ltd., North Ryde). 1986. 45p. Australian Coal Industry Research Laboratories, North Ryde, Australia.

To assist in the ultimate development of a technique for the prediction and control of outbursts in coal mines, a system for the recording of such events has been developed. The resulting outburst reporting system consists of a questionnaire type reporting form supported by a computer database with facilities for the entry, storage and retrieval of the information gathered from cooperating collieries. The reporting form is intended for completion as soon as possible after an outburst event ideally by willing deputies and augmented by observations made by an under-manager and/or mine geologist. Already 202 separate past outburst events have been stored on the database. Recommendations regarding further development and the application of the reporting system are made.

10773 (BHRA-RR—2550) Survey of water jet roadway cutting. Fairhurst, R.M. (British Hydromechanics Research Association, Cranfield). Jan 1986. 20p. British Hydromechanics Research Association, Cranfield.

BHRA Project RP A02789.

This report covers a literature survey conducted on behalf of British Gas into water jet roadway cutting techniques. Water jets either on their own, with abrasive addition or in conjunction with mechanical cutting devices are considered. 50 refs.

10774 (ERP/CRL—85-28(TR)) Gob leakage in 8 East at Lingan colliery. Stokes, A.W. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Mar 1985. 20p. Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.

This paper reports on a comprehensive air leakage survey around 8 East longwall, Sydney Coalfield, Nova Scotia. The information collected provides base data from which the resistance of the so called gob corridors could be calculated. It also provides a better understanding of the resistance to the passage of air offered by the rocks in the gob, and a knowledge of areas where measures should be taken to reduce the leakage. Recommendations for future studies in this area are made. 2 refs.

10775 (ERP/CRL—85-108) Truck management systems review. Srajer, V. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Dec 1985. 37p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Truck monitoring systems currently available in North America are reviewed. All systems are evaluated based on their functions, diagnostics, and integrated system control. It is recommended that as the non-operator dependent on-board truck management system (OBDAS) appears to be the best system a field test should be undertaken. (35 refs.)

10776 (ERP/CRL—86-1) State-of-the-art of microseismic application for mining. Vladut, T.I. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jan 1986. 99p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

The principles of acoustic monitoring and an overview of its potential uses in the mining industry are provided. The focus of the

report includes the use of microseismic monitoring on underground hard rock mining including rockburst applications, soft rock mining including coal, and application for open cast operations. Laboratory and analytical developments and their potential application are also examined. A review of equipment specifications, installation problems, and economic aspects of implementation of acoustic monitoring is included. (48 refs.)

10777 **(ERP/CRL—86-3) 'Sub #4' user guide: computer calculation of longwall subsidence profiles using the NCB Subsidence Engineers Handbook.** Young, D.A.; Aston, T.R.C. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jan 1986. 54p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

A computer program 'Sub #4' undertakes the calculation and plotting of longwall subsidence profiles using the National Coal Board (United Kingdom) Subsidence Engineers Handbook. The program is written in G-BASIC for a North Star microcomputer.

10778 **(ERP/CRL—86-17(IR)) Some common features of retreat longwall panels in highly productive mines.** Haslett, G.A.; Stewart, D.B. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Feb 1986. 22p. Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.

The working conditions and mining equipment of four highly productive mines are compared. Three of the mines are located in West Virginia, USA and the fourth mine is located in New South Wales, Australia. One features all the mines have in common is the use of a longwall retreat panel. An examination of equipment revealed all also employed the principle of over-design in the use of heavy duty equipment which enhances equipment reliability and productivity. Variations in depths of mining, working conditions and proximate geology for the four mines are included. One mine experienced high methane emissions which requires specific drainage systems and drilling techniques be employed. 1 ref.

10779 **(ERP/CRL—86-26(TR)) An evaluation of 9 East's monolithic packing as a gob sealant.** Stokes, A.W. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Mar 1986. 23p. Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.

The effectiveness of gateside packing systems for reducing air leakage through longwall wastes is examined. A survey of a monolithic packing system on 9 East longwall in the Lingan Colliery shows that monolithic packing does reduce air leakage and could allow a 2500 m longwall to be completed without using cundy ventilation. The results of this survey are compared to 4 West and 8 East results. A computer model developed to simulate the effect of using monolithic packing can be used to predict increased load on the mines' ventilation system. 5 refs.

10780 **(ERP/CRL—86-45(TR)) In situ gas permeability testing in the No. 2 and No. 3 tunnels, Donkin-Morien project, Nova Scotia.** Gallant, W.D.; Hamilton, D.M.; Aston, T.R.C. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Apr 1986. 33p. Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.

In situ gas permeability testing was undertaken in two Sydney Coalfield tunnels. The object of this study was to determine whether this technique could be used effectively to determine the extent of the zone of disturbance created by the two excavation techniques used in the No. 2 (tunnel boring machines) and No. 3 (drill and blast) tunnels. Results indicate that the zone of disturbed strata around the No. 3 tunnel is three times the size of the equivalent zone surrounding the No. 2 tunnel. 5 refs.

10781 **(ERP/CRL—86-46(OP,J)) Less conventional methods for mining underground coal.** Muirhead, I.R.; Kolada, R.J. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Apr 1986. 46p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

This paper discusses a number of less conventional underground coal mining methods, focussing on those which show the most promise for application to western Canadian coal deposits. The methods were divided into two categories: those recently introduced and working in operating mines, and those which have either never been tried or only used for short periods. Also included is an assessment of Canadian coal deposits suitable for underground mining. 6 refs.

10782 **(EUR—10641-DE) Further development of support technology for service trunk roads and gate roads.** Goetze, W. (Commission of the European Communities, Luxembourg). 1986. 130p. (In German). Commission of the European Communities, Luxembourg.

This paper describes developments in strata control in mine roadways. The following aspects are covered: arch support and proposals for improving yielding arch support methods, including mortar-type backfilling, correct choice of arch shape, arch design, and segment overlapping; a method for calculation of support stability in face end areas for conveyor gates of inclined coalfaces; use of strata bolts for reinforcing yielding arch support in the face end area; support problems in spine roads; strata bolting combined with immediately bearing shotcreting; backfill and roadside pack techniques, including development of immediately bearing roadside pack mortar; and reduction of roadway convergence by stress relief slots or stress relief chambers.

10783 **(NERDDP-EG—85-495) Outburst research.** Beamish, B.B.; Hungerford, F.; McKavanagh, B.; Williams, R.J. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). Aug 1985. 760p. Department of Resources and Energy, GPO Box 858, Canberra, Australia 2601.

The outburst-proneness of the majority of underground coal reserves at Collinsville in the northern Bowen Basin, Queensland, has made it imperative that a solution be found to the outburst problem. Initial research centered on defining the regional extent of the problem. Gas content determinations were conducted on bore core from all the seams. A desorbable gas content in excess of 5 m^3/t was found to correlate to outburst-prone conditions in the underground Bowen seam workings. Subsequent research has concentrated on (a) developing a face monitoring system for detection of outburst-prone conditions at the working faces and (b) longhole inseam drilling and seam gas drainage to alleviate outburst prone conditions. The face monitoring system incorporated continuous gas monitoring and rock noise monitoring. Rotary drilling of in-seam boreholes to depths of 300 m was achieved for gas drainage, but drilling rates were affected by machine breakdowns and drainage by complex geology.

10784 **(VTT-TUTK—408) Possibilities to utilize field screening for milled peat.** Frilander, P.; Kautto, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 43p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750643.

The function of a field screening plant as well as the properties of screened peat were studied in this research. Also the effect of screening on the function of heating plants was evaluated. The function and properties of the field screening plant were studied in test drives on different bogs. Most disturbances in the screening plant were caused by plastic covers of stockpiles. The screen removed grains bigger than 50 mm from milled peat. The amount of reject was about 0.7-4% of all peat screened. The density of screened peat was 1-4% lower than that of unscreened peat. This depends partly on humidity, because screened peat is drier than unscreened peat. During the transport by lorries the sinking of the peat load was 5.1-8.2%. This depends mainly on the transport distance and less on the influence of screening. The amount of reject was 0.1% in the heating plants were studied. The amount of reject in unscreened peat was 1.3-2.2%. When field screened peat was delivered to heating plants, disturbances clearly decreased in their peat handling equipment. At the same time the consumption of the supporting fuel (oil) was decreased. The use of field screened peat is most advantageous to small heating plants. They are more oppressed by the costs of peat handling chains than large heating

plants. The amount of peat annually used is, however, so small that reaching a delivery of 100,000 m/sup 3/ requires deliveries to several plants from one screening plant. An indicative calculation, which was done in a small heating plant (7 MW), proved that the financial benefit received by using field screened peat clearly exceeded the costs of sceening mentioned above. A long-term follow-up of the function of a commercial field-screening plant, which will possibly be built, is the next most interesting thing in the field screening research.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 10748

10785 **(BHRA-RR—1962) Negative pressure pneumatic conveying systems for CEGB power stations.** Baker, P.J.; Headford, A.L. (BHRA Fluid Engineering, Cranfield (UK)). Feb 1983. 33p. BHRA Fluid Engineering, Cranfield, England.

This report evaluates published techniques for performing design calculations on pneumatic conveying processes, with particular reference to the design of systems operating in vacuum mode. Preferred methods for each aspect of the calculation are selected on the basis of practicability and anticipated reliability. A procedure is recommended for applying these methods to the design of power station conveying systems. The requirements, uses and limitations of this procedure are described and important features of the engineering design identified. The report concludes that acceptable design calculations can be performed, although there are reservations regarding the transport of small particles, the effect of pipe size, the accuracy of the predictions and the behaviour of objects other than granular materials. Recommendations are made for further work to improve confidence in the available methods and to develop the techniques to provide sufficiently accurate results for a wide range of cases.

10786 (EPRI-EA—4857, pp 16.1-16.20) **Coal transportation pricing.** Mehring, J.S. (Resource Management Systems, Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Prior to the Railroad Revitalization and Regulatory Reform Act of 1976, all rail rates were subject to regulatory constraints. Established rates usually increased at the same rate as rail costs. New rates, although subject to regulatory constraints, often reflected market forces. With the passing of the 4-R Act and the Staggers Act of 1980, rates became subject to review only if markets show an absence of effective competition. The acts have given carriers the ability to establish prices without regulatory review in an increasing number of markets. A discussion of the factors that determine the level of rates is presented and the changes in average state-to-state coal rail rates that occurred between 1973 and 1983 are examined. This period included major legislation and decisions that affected rates, namely the 4-R Act of 1976, Ex Parte 347 the Western Coal Rate Investigation - Guidelines for Railroad Rate Structure and later its Sub No. 1 Coal Rate Guidelines Nationwide and the Staggers Rail Act of 1980. How rates would likely be formed in today's environment and how to predict these rates are discussed.

10787 (EPRI-EA—4857, pp 17.1-17.13) **Changing commercial practices in the coal industry: facts and fiction.** Weinstein, D.M. (Putnam, Hayes & Bartlett, Inc., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

The coal industry today is dynamic; changes are occurring in production, transportation and consumption. These changes are interrelated. The major changes in the railroad industry affect the actions of coal producers, and in turn the strategies and tactics of coal producers affect the behavior of utilities. However, some of the much-discussed and often-publicized changes are more fiction than fact or at least are greatly exaggerated. What is undeniably true is that the dynamic coal markets of today provide risk for utility fuel buyers and planners and more importantly afford substantial opportunity for innovation in utility fuel procurement and substantial opportunity for lowering coal procurement costs. These changing commercial practices in the coal industry are discussed.

10788 **(STEV-FBA—86-7) Agglomeration of pulverized coal.** Gierse, M. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). 31 Jul 1985. 44p. (In Swedish). (STUDSVIK-EB—85-59). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750628.

An experimental evaluation of the forces and conditions which influences on the agglomeration of pulverized coal at pneumatic transport to a burner. A decrease in the particle size increased the agglomeration. The cause of agglomeration was Van der Waal's forces. Turbulent conditions in the transport pipe could easily break the aggregates. (K.A.E.).

10789 **Optimum wearing high efficiency design of phosphate slurry pumps.** Roco, M.C.; Addie, G.R.; Visintainer, R.J.; Ray, E.L. (Univ. of Kentucky). pp 277-286 of Proceedings of the eleventh international conference on slurry technology. Washington, DC; Slurry Transport Association (1986). (CONF-860341—).

From 11. slurry technology international conference; Hilton Head, SC, USA (16 Mar 1986).

The computer-aided-design is becoming more important in the fluid machinery industry as a tool in the design decision making process, and economical manufacturing in shorter time. It promotes the use of numerical methods for the prediction of flow indices, wear distribution, stress distribution, vibrations, etc. This paper presents an approach to optimize the centrifugal slurry pumps using a computer, with a phosphate matrix slurry pump example. The optimization of the pump design should aim at the following: 1. High energy efficiency at the operating duty (flow-rate, pumping head, slurry indices); 2. Good wear resistance of the wetted components to the slurry being pumped, including the selection of the pump wear materials for the transported solid particles, slurry indices and predominant wear mechanism; 3. High reliability in operation, including the ability to pass large sized solids at the prescribed concentration, and high bearing and shaft life; and 4. Lower manufacturing cost by reducing the overall size and wall thickness of the pump components, improving manufacturing processes, etc.

0140 Combustion

REFER ALSO TO CITATION(S) 10698, 10735, 10739, 10763, 10838, 11136, 11152

10790 **(ANL/CNSV—57) A modeling study of pulverized coal combustion in CO_2/O_2 atmospheres.** Berry, G.F.; Wang, C.S.; Chang, K.C.; Wolsky, A.M.; Choi, U.S. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31-109-ENG-38. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003284.

In this modeling study, a one-dimensional coal combustion or gasification (1-DICOG) computer code was used to simulate differences in the combustion performance of pulverized coal resulting from the substitution of various CO_2/O_2 mixtures as a replacement for air in the combustion process. Predictions using this simple, one-dimensional model were compared with actual performance data from tests designed by Argonne National Laboratory and conducted by Battelle Columbus Division. The resulting comparisons of predicted and measured data for all test cases show that the observed trends of distributions of temperature and of species concentrations are predictable; numerical discrepancies between predictions and measurements of these data are attributed to limitations of the 1-DICOG computer code. Coal burnout in the test combustor was also analyzed. This information is required to determine axial burnout variation. The study finds that the combustion processes of pulverized coal can be completed in an atmosphere of O_2 and O_2 over a range of CO_2-to-O_2 mole ratios between 2.23 and 3.65. The report also describes results obtained using PCGC-2, a two-dimen-

sional model. Comparisons between the results of 1-DICOG and PCGC-2 are presented. The latter are more detailed and agree better with experimental observations. 14 refs., 61 figs., 21 tabs.

10791 (ANL/FE—86-7) **Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas: Annual report, October 1984-September 1985.** Lee, S.H.D.; Henry, R.F.; Smith, S.D.; Wilson, W.I.; Myles, K.M. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31-109-ENG-38. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003969.

A laboratory-scale pressurized fluidized-bed coal combustor (PFBC)/alkali sorber was used (1) to measure the alkali vapor (Na and K) concentration in PFBC flue gas on a real-time on-line basis, and (2) to demonstrate simultaneously the granular-bed sorber concept for the removal of alkali vapors from hot PFBC flue gas. An Ames alkali analyzer was used as an on-line, real-time monitor. A batch-type alkali and particulate sampling train (APST) was also installed as a backup for the analysis of both alkali vapor and particulate loading in the flue gas. The test results showed that the particulate loading in the flue gas which exited from the tertiary cyclone varied from 150 to 350 ppMW. The alkali vapor concentration measured by the Ames alkali analyzer was <10 ppBW, which is 1 to 2 orders of magnitude greater than that measured by the batch-type APST. However, consideration of the analytical uncertainty of the two measuring techniques indicated that the difference may not be as great as observed. The analysis of the alkali contents in fly ash samples suggested a negligible evolution of potassium in coal during combustion; however, a significant evolution of sodium was indicated. In a series of laboratory tests, heated (>700°C) stainless steel tubing was shown to capture NaCl vapor. This observation suggested that the stainless steel tubing and parts used in the flue gas sampling line of the PFBC/alkali sorber facility could be a sink for the sodium vapor. Further study is needed to verify this postulation. 22 refs., 7 tabs., 15 figs.

10792 (DOE/FC/10627—2229) **Surface adhesion of low-rank coal ash: Quarterly report, April 1986-June 1986.** Austin, L.G.; Benson, S.; Conn, R. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Aug 1986. Contract AC21-85FC10627. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003707.

The adhesive properties of ion-exchanged Center lignite ash were evaluated using the sticking apparatus. ASTM ash from ion-exchanged Center lignite was suspended on a platinum and heated in a methane-oxygen flame of adiabatic temperature between 1650° and 1750°C. The resultant molten slag was dropped onto an oxidized carbon steel surface. The ion-exchanged Center lignite ash had a sticking temperature of 550°C. The sticking temperature of the raw Center lignite ash was considerably lower ($\sim$375°C) as reported previously. The higher sticking temperature of the ion-exchanged ash was probably due to removal of sodium and calcium from the Center lignite. The gas-fired vertical tube furnace was used to form deposits with Center lignite, San Miguel lignite, Rosebud sub-bituminous coal and Navajo sub-bituminous coal. The objectives of these tests were to evaluate (1) the effect of oxygen partial pressure during combustion on deposit characteristics of the four coals and (2) the effect of hot zone temperature on deposit characteristics of Rosebud and Navajo sub-bituminous coals. Increasing the furnace oxygen partial pressure from 20 to 60% O_2 was generally found to decrease the deposit formation rates and strengths. X-ray diffraction analyses of deposits formed during the 60% O_2 tests indicated that less alkali/silica interactions had occurred compared to the tests performed with 20% excess air. Decreasing the furnace hot zone temperature was found to decrease deposit formation rate and strength for the Rosebud coal. These trends were also observed for Rosebud coal which had been ion-exchanged. 3 refs., 5 figs., 6 tabs.

10793 (DOE/METC—86/6041, pp 1-3) **US Department of Energy, fossil energy research and development program.** Swink, D. (Dept. of Energy, Germantown, MD). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The emphasis of the US DOE Fossil Energy Program is turning to small applications technology now that coal has 55 percent of the market for fuels for the utility sector. Examples are given from the United Kingdom, India, and South Africa of minimum treatment to coal for consumption by the commercial and residential sectors. Research programs are directed towards advance combustion, atmospheric fluidized-bed combustion, alternative fuels, surface gasification, and heat engines. In the heat engine program, the major emphasis is on transportation applications: direct coal-fired, coal gas-fired, coal water mixture-fired, and coal liquid-fired.

10794 (DOE/METC—86/6041, pp 4-8) **Coal-fueled heat engines: an energy plan for a strong America.** Wallace, F.B. (General Motors Corp., Indianapolis, IN). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

Several aspects of the development of coal-fired gas turbines are discussed: the overall economic environment; applications for the coal-fired gas turbine; technology needs; and government policy considerations. It is concluded that the health of the US economy is such that the perfection and deployment of this technology to offset oil and gas consumption is mandatory. The initial applications should be locomotives and cogeneration, with growth toward base-load electric power and toward other transportation applications.

10795 (DOE/METC—86/6041, pp 9-20) **Coal fuel diesel engines for stationary power.** Benedek, K.; McCullough, J.; Rao, K.; Cheng, W. (Arthur D. Little, Inc., Cambridge, MA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-85MC22182.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The goal of this program is to establish a foundation of knowledge which can serve as a design basis for the development of coal engines. Cooper Bessemer, a leading manufacturer of large stationary engines, has pioneered many developments such as alternate fuel use, lean burn technology, and extremely low maintenance engine designs. At this stage, it is not prudent for Cooper to proceed directly to the design of a prototype coal-fueled reciprocating engine; there are too many unresolved design issues. This study seeks basic knowledge which is lacking in the following areas: application, economics, fuels, injection systems, combustion systems, erosion by ash, and emission. The objective of this METC project is to conduct highly focused exploratory studies in these seven areas, with particular emphasis on injection and erosion issues. The most suitable applications for a stationary coal diesel are industrial cogeneration plants and modular electric generating plants (5-50 MW). This paper discusses the fuel and economics for these two applications.

10796 (DOE/METC—86/6041, pp 21-30) **Coal fueled diesel systems research.** Leonard, G.; Fiske, G.; Giles, W.; Spiro, C.; Fisher, R.; Hapeman, M.; Hsu, B.; Flynn, P. (General Electric Corp. Research and Development, Schenectady, NY). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-85MC22181.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objective of this program is to evaluate the technical feasibility and economic reality of building a coal-fueled diesel powered locomotive. The technical feasibility is being examined by the use of lab and bench scale experiments designed to determine practical concepts for the high-pressure injection of coal water slurries (CWS), the effect of coal fuel variables on pumping and atomization characteristics, and the effect of combustor design and coal fuel variables on the combustion characteristics of CWS. The major accomplishments to date include the completion of coal fueled diesel locomotive economic assessment, a substantial data base of coal/water slurry ignition and combustion characteristics in a combustion bomb and some preliminary testing on the GE single cylinder test engine. These results are presented and discussed.

10797 (DOE/METC—86/6041, pp 31-40) **Coal-fueled diesel systems research.** Koch, R.L.; Braglia, B.L.; Ryan, T.W. III. (Allison Gas Turbine Div., Indianapolis, IN). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-85MC22123.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The overall objective is to investigate the economic characteristics and technical features for a coal-fueled diesel system. Commercialization merits of coal-fueled diesel locomotives will be examined and bench scale tests will be conducted to determine the effect of selected coal fuels on fuel storage, handling, injection, ignition, combustion, and engine wear. The primary result in this program to date is the economic assessment of the coal fueled diesel locomotive. Operational considerations, economic evaluation criteria, and a discussion and conclusions of the economic evaluation are presented. Data acquisition in the test program is just beginning, but the program is briefly described. 7 references.

10798 (DOE/METC—86/6041, pp 41-52) **Low emission combustor technology.** LeCren, R.T. (Solar Turbines Inc., San Diego, CA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-82MC20229.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

A two stage coal-water mixture, high-pressure gas turbine combustion system employing a primary zone with a hot refractory wall and an internal slag removal system has been designed, built and tested. This two-stage slagging combustor (TSSC) is shown in a figure. The molten ash is removed by aerodynamic means using a form of jet impaction. The combustor was tested with the primary zone operating in the rich mode and the secondary operating in a lean mode. The results using coal water slurries were reported at the 1985 Heat Engine Conference. A contract add-on was issued to assess the effects of burning dry coal in this combustor. The add-on program included the design and fabrication of a dry coal feed system. This paper discusses the development and testing of the dry coal feed system and presents results on the emission of nitrogen oxides and carbon monoxide from the combustor using both dry coal and CWM at two different pressure levels, 40 and 80 psig.

10799 (DOE/METC—86/6041, pp 53-63) **Gas turbine component screening program - fuel flexible combustor.** White, D.J.; Cowell, L.H. (Solar Turbines Inc., San Diego, CA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21284.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objectives of this program are to move into the next phase of the two-stage slagging combustor (TSSC) evaluation using the data and information from Solar's earlier combustor program. The specific objectives are: (1) to gain an understanding of combustion requirements and mechanisms as a function of the combustor design and the physical properties of coal-derived fuels and (2) to characterize the products of combustion from the TSSC and gain an understanding of their effects on gas turbine hot end components. An improved larger-scale TSSC has been designed and built, and testing has started. The improvements over the previous design include a shorter, larger-diameter primary zone; an annular gap slag pit; a redesigned fuel injector; and increased size (1/10 Centaur scale vs. 1/12). The combustor will be tested using three different coal-water slurry fuels at two different test conditions to determine emissions signature and combustor performance. These tests will be followed by a deposition run. The two combustors are described. Testing to date has been accomplished using a CWM supplied by AMAX. There is 3% ash in the coal, the loading is 60%, particle size is 8-10 microns mean and 44 microns maximum. The viscosity is 400 centipoises at a shear rate of 100 reciprocal seconds. Test results can be summarized as follows. (1) NOx is below 125 ppm at the design point. (2) The combustor operates stably over a wide range. (3) Some problems have been encountered with overheating in the slag pit.

10800 (DOE/METC—86/6041, pp 64-74) **Gas turbine components screening.** Wilkes, C.; Fox, R.; Williams, J.; Ames, F.; Wenglarz, R. (General Motors Corp., Indianapolis, IN). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21394.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objectives of this program are to: further develop a variable geometry rich-quench-lean (RQL) combustor to achieve high combustion efficiencies and low emission levels using coal fuels and gain understanding of the deposition, erosion, corrosion, (DEC) effects of the RQL products of combustion for operation with coal-water fuels. The test facility is described, the three fuels are characterized, and results from combustor development tests, combustion and emission testing of fuels, and the DEC effects from the tested fuels are discussed. 7 references.

10801 (DOE/METC—86/6041, pp 75-79) **Gas Turbine Component Screening Program.** Neuzil, P.A.; Haskell, R. (General Electric Co., Schnectady, NY). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21395.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objectives of the DOE/General Electric Gas Turbine Component Screening Program are to: confirm that the heat release of commercially acceptable coal/water fuels is high enough for heavy-duty industrial gas turbine operating pressures, temperatures, and flows; initiate the experimental and analytical development of a full-size, direct fired, coal/water fueled combustor suitable for commercial application; investigate deposition rates and characteristics of ash produced by direct firing coal/water fuels at gas turbine operating conditions; and characterize the products of combustion from direct fired coal/water fuels. Most of the work completed to date has been in the combustor development phase of the program. Although combustion efficiencies as high as 99% have been measured, sustained combustion on 100% CWM (i.e., without supplemental fuel) has not yet been achieved. The combustor and fuel are described and results are discussed.

10802 (DOE/METC—86/6041, pp 80-91) **Coal water mixture combustion technology development.** Rosfjord, T.J. (United Technologies Research Center, East Hartford, CT). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-83MC20404.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

United Technologies Research Center has completed a comprehensive investigation of the combustion characteristics of coal-water mixture (CWM) fuel for use in gas turbine combustors. Included in the program have been studies of the physical and chemical processes involved in CWM combustion. In particular, sub-rig test programs were performed to document the level of atomization achieved by candidate fuel nozzles and to evaluate the mixing/stability characteristics as evidenced by flow patterns in the combustor. Additionally, an extensive investigation of the pyrolysis behavior of coals used in the preparation of CWM fuels has been conducted for the high heat flux conditions experienced in a gas turbine combustor. These several activities were performed in preparation for tests in a combustor rig which simulated full-load gas turbine combustor conditions. This paper summarizes the results of the comprehensive investigation.

10803 (DOE/METC—86/6041, pp 92-103) **Alkali species characterization for coal-fueled gas turbines.** Spiro, C.L.; Chen, C.C. (General Electric Corporate Research and Development, Schenectady, NY). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-85MC22164.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

Combustion/deposition testing with coal water mixtures (CWMs) has been combined with extensive physical and chemical characterization for the purpose of examining ash and, in particular,

alkali transformations in the gas turbine hot gas path. Combustion/deposition testing has been performed in two test rigs in which thermodynamic and aerodynamic similarity to real gas turbines has been maintained. Low residence time (< 20 msec) can combustors were used, with firing temperatures in the range of 1700 to 2000 F. Ash samples were obtained as deposits on cooled deposition surfaces and as particulate material collected from the hot gas path. EXAFS spectroscopy has been an important tool in identifying the forms of coal ash species, and has been applied to the study of potassium transformation chemistry since alkali plays a major role in corrosion and deposition in gas turbines. Detailed analyses of deposits and products of combustion combined with experimental observations of coal ash behavior such as deposition rate form a basis for an initial evaluation of fuel-property/engine-requirements tradeoffs. After describing test facilities, methods and results from ash transformation tests, deposition rate studies and the chemical and physical characterizations are discussed.

10804 (DOE/METC—86/6041, pp 104-118) **Combustion of coal/water mixtures with thermal preconditioning.** Novack, M.; Roffe, G.; Miller, G. (General Applied Science Labs., Inc., Westbury, NY). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21390.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objectives of this program are to build and operate a thermal preconditioning apparatus capable of converting 300 lb/hr of coal/water mixture into a superheated suspension of coal and char particles in dry steam, to burn the preconditioned mixture in a laboratory gas turbine combustor simulator and measure the combustion characteristics of the system, to determine the relationship between preconditioning temperature and the evolution of volatiles and gaseous sulfur species and to investigate the system implications of adding the process to stationary and mobile gas turbine installations. Experimental facilities, performance tests, and fuels are described. Combustion efficiency of the system is discussed. 8 references.

10805 (DOE/METC—86/6041, pp 119-134) **Alternate gas turbine injection techniques.** Dodge, L.G.; Moulton, D.S.; Mannheimer, R.J. (Southwest Research Institute, San Antonio, TX). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21391.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

There are four objectives of this program: (1) characterize a dry-powder coal injector with fuel delivery into air at both atmospheric pressure and elevated pressure; (2) characterize a spinning disc or cup atomizer for injection of slurries into air at both atmospheric pressure and elevated pressure; (3) develop these two injection systems sufficiently so that they can be used in combustion experiments; and (4) conduct combustion experiments to examine the effects of initial coal size, size distribution of particles (droplets for slurry fuels) at injection, and residence time and temperature (both inlet and combustion) on the burnout rate of coal volatiles and char. Both the slurry and dry-powder injection systems are described, as well as some of the results of testing each system. First, the coal preparation and analyses are discussed. Then, because of the importance of rheology to the atomization of slurries, the measurements of viscosity as a function of shear rate are described, followed by the results of slurry atomization by rotary nozzles and cups. This is followed by a description of the dry-powder injection system and results of combustion tests. 7 references.

10806 (DOE/METC—86/6041, pp 135-141) **Evaluation of calcium impregnated coal as a fuel for turbine combustors.** Reuther, J.J.; Conkle, H.N. (Battelle Columbus Lab., OH). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21289.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objectives of this DOE/METC Heat Engines program were twofold: to parametrically and experimentally determine the comparative in situ SO_2, NO/sub x/, and particulate controlling capacity of calcium doped coals under simulated combustion turbine conditions as a function of: super-atmospheric pressure, firing temperature, raw coal organic sulfur content, molar calcium/sulfur ratio, calcium source, and calcium loading technique; to analytically determine the technical and economic feasibility of directly firing calcium-loaded coal in a combustion turbine. The focus of most research attention was on the sulfur capture efficiency of Battelle Treated Coal. BTC, as it is commonly referred to, consists of high-sulfur (> 4 weight %) Illinois No. 6 bituminous coal that has been impregnated with calcium using a proprietary Battelle process. During the course of the investigation, data on ash fusion temperatures, free-swelling indices, NO/sub x/ emissions and flyash particle size were also obtained. Results are given and discussed.

10807 (DOE/METC—86/6041, pp 142-151) **Evaluation of alternate combustor concepts for gas turbine applications.** Pillsbury, P.W. (Westinghouse Electric Corp., Concordville, PA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

This paper discusses the design of the slagging combustor for burning coal/water mixture (CWM) and dry pulverized coal. The combustor was designed to satisfy the requirements for efficient combustion and slagging capability including the residence time requirements for ignition, flame stability, devolatilization of the coal particles, and char burn-out. A primary objective of this combustor is the removal of most of the coal ash by the slag, thus minimizing the amount in the products of combustion. The combustor is designed and operated with rich primary and lean secondary stages, respectively, which will limit the NO/sub x/ production from the fuel bound nitrogen in the coal and also from thermal fixation of atmospheric nitrogen. The primary zone design favors retention of sulfur in the slag. The combustor and test rig together with the test fuels and their injector are discussed in this paper. Two fuel forwarding systems, a slurry forwarding and a dry pulverized coal feed system, have been considered in this program. The test program and the planned measurements to satisfy the objectives are outlined. Initial combustion test results are discussed. Future testing planned includes determining the effect of primary zone equivalence ratio on the slagging capability of this combustor burning CWM.

10808 (DOE/METC—86/6041, pp 152-162) **Combustion and fuel bound contaminant control with a staged cyclone coal combustor for gas turbines.** Zauderer, B.; Fleming, E.; Swift, B. (Coal Tech Corp., Merion, PA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21389.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The overall project objective is the evaluate operational parameters affecting contaminant control during staged, cyclone coal combustion, under conditions simulating direct coal firing into a gas turbine. Specific research objectives are: determine the range of staged cyclone combustor operating conditions which are compatible with optimum gas turbine performance; determine the feasibility of sulfur control in the combustor with limestone injection; investigate the fate of alkalies in coal combustion; investigate combustor operation under staged conditions for NO/sub x/ control; and integrate the above results to provide a combustor operating envelope for gas turbines. The project includes an experimental effort on an atmospheric, 7 MMBTU/hr, two stage, cyclone combustor, operating at gas turbine exhaust temperatures, which is being fired with coals, specially selected to highlight sulfur control methods. After describing the coals used, the paper discusses carbon conversion and fuel-air mixing, ceramic liner erosion, nitrogen oxides results, sulfur reduction with limestone injection, slag analysis, and alkali evolution in the slagging combustor.

10809 (DOE/METC—86/6041, pp 163-175) **Combustion research for advanced heat engine power system.** Dunn-Rankin, D.; Hoornstra, J.; Holve, D.J. (Sandia National Labs., Livermore, CA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The primary project objective is to determine the physical characteristics necessary to make pulverized coal (PC) and coal/water slurry (CWS) viable fuels in heat engines, such as medium speed diesels and turbines, that have traditionally relied on liquid and gaseous fuels. The understanding of the evolution of the particle size distribution during PC and CWS combustion, and the relation of this evolution to the physical properties of the fuel is the major thrust of our work. An in-situ laser-based particle-counter-sizer-velocimeter (PCSV) was used to measure the particle size evolution during combustion of pulverized coal and coal/water slurries in a laboratory scale laminar flow reactor. The initial particle size distribution was also measured to distinguish effects of fuel preparation on the subsequent combustion behavior. Supplementary information comes from scanning electron microscopy analyses of fuel samples that have been extracted during combustion and quenched with a helium quench probe. The present study determines experimentally the influence of coal rank on agglomeration and subsequent combustion of coal/water slurries by measuring the particle size distribution of the slurries after different residence times in a laminar flow reactor. 12 references.

10810 (DOE/METC—86/6041, pp 176-188) **Structure of fine-grained CWF flames: NO/sub x/ reduction by staged combustion.** Beer, J.M.; Toqan, M.A. (Massachusetts Institute of Technology, Cambridge). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The detailed flame structure, i.e., the spatial distributions of gas and particle velocities, temperatures, and chemical species concentrations in the flame, is of great interest for the design of burners and combustors with improved performance. Previous tests with fuel slurries at the MIT Combustion Research Facility showed very good burnout, but high NOx emissions. The research objective of the present series of studies was to use staged combustion air injection for reducing the NOx emission without any loss in carbon conversion efficiency. Measurements are described and the results are discussed.

10811 (DOE/METC—86/6041, pp 189-204) **Sorption of fuel-bound contaminants for coal and CWM-fired gas turbine systems.** Garman, A.R.; Simons, G.A.; Parker, T.E.; Johnson, S.A. (Physical Sciences Inc., Andover, MA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objectives of this exploratory research program are to quantify the sorption of sulfur and alkali species under well controlled conditions and to determine the extent of interaction between the sorbents used for removal of these species and the coal ash in its various modes of appearance in heat engine combustion systems. Secondary objectives are to develop and validate predictive models for sulfur and alkali sorption and to obtain estimates for the capture of these species in potential heat engine applications. This paper discusses: (1) the measurement of alkali sorption rates for a number of candidate alkali sorbents and demonstration that the rates of removal to the low ppm range are too slow for entrained flow applications; (2) the definition of potential mechanisms for sulfur sorbent reactivity enhancement by volatilized alkali species and demonstration of alkali capture by calcium-based sorbents; and (3) the measurement of sulfur sorption rates in an entrained flow configuration, with and without coal ash present and validation of the PSI porous sorbent model in entrained flow conditions. 18 references.

10812 (DOE/METC—86/6041, pp 205-218) **Mechanism of deposition in coal-fired gas turbine systems.** Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objective of this study is to develop mathematical models which describe ash particle and vapor formation and transport in coal-fired gas turbines. These will characterize the important surface deposition phenomena on turbine blades and assess the effects of coal pretreatment and the range of operating conditions on turbine performance. This report presents some fine tuning of the deposition processes in a coal-fired gas turbine. The boundary layer nucleation theory gives the correct trends. The probabilistic sticking coefficient model agrees quite well with experimental data. The gas phase simulations glean insight into the mechanism of SO_3 and Na_2SO_4 production. Much work remains in these last two: particle adhesion model refinement, and heterogeneous formation of Na_2SO_4. 11 references.

10813 (DOE/METC—86/6041, pp 219-226) **Experiments on coal mineral matter deposition from combustion gases.** Rosner, D.E. (Yale Univ., New Haven, CT). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-85MC22075.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

Experiments were designed and performed on submicron particle deposition (PD) and multiple alkali sulfate vapor deposition (VD) using optical techniques and well-characterized, seeded hydrocarbon/air flat flames at atmospheric pressure. The results are being used to develop a quantitative understanding of the effects of particle thermophoresis (migration down a temperature gradient) and boundary layer (BL) vapor nucleation-growth on net deposition rates. This is being accomplished via iterative comparisons between our experimental results and the predictions of our recent mass transfer BL theories. The correlations which economically summarize these findings will provide the basis for predicting and controlling the deposition rate behavior of cooled combustion turbine blades, and combustor walls exposed to ash- and salt-laden combustion products.

10814 (DOE/METC—86/6041, pp 227-256) **Study of deposition control using transpiration.** Louis, J.F.; Kozlu, H. (Massachusetts Institute of Technology, Cambridge). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The purpose of this project is to determine the conditions under which transpiration may be actually used to avoid deposition of small particles. The application of this work is the control of the deposition of small particles over a surface kept at a temperature below the melting point of compounds likely to exist in the combustion products. A combined experimental and theoretical research program was carried out to evaluate the concept of transpiration as a deposition control strategy. A first order theory was refined by introducing an appropriate turbulence model. The experimental program is designed to evaluate and refine the theoretical model under conditions which provide the correct Reynolds and Stokes numbers. The experimental set up consists of a wind tunnel with a test section containing a flat porous transpired section. The measurements determined the distribution of velocity and of particle concentration in the boundary layer. The experiments were conducted for different particle sizes under conditions simulating gas turbine conditions. Results are discussed. 10 references.

10815 (DOE/METC—86/6041, pp 257-270) **Combustion characteristics of coal fuels in adiabatic diesel engines.** Kakwani, R.M.; Woods, M.E.; Valdmanis, E. (Adiabatics, Inc., Columbus, IN). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21099.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objective of this contract was to conduct a test program aimed at utilizing an uncooled adiabatic diesel engine configuration to improve the combustion characteristics of fine coal powder (fumigated into the intake manifold). Our main emphasis was on improving the combustion of fumigated powdered coal fuel in an uncooled insulated engine. The test plan was to ignite the powdered coal with a standard diesel pilot (DF-2) and burn only up to 50% micronized coal powder in a single cylinder diesel test engine. Engine performance was to be noted in two engine configurations:

(1) watercooled and (2) uncooled insulated (adiabatic). The test fuels in these two engine configurations were planned to be; (2) DF-2, and (b) DF-2 plus up to 50% coal powder. The concept of thermal ignition in micronized coal combustion was discovered and thus the program was altered somewhat to operate without a diesel pilot injection or limitation on 50% coal fuel input. The program ultimately was able to operate as a 100% coal fueled adiabatic diesel engine without any external ignition aids. The fuels and engines are characterized and results are discussed on the performance of the engines. 12 references.

10816 (DOE/METC—86/6041, pp 271-284) **Combustion characteristics of coal fuels in adiabatic diesel engines.** Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21384.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The overall objective of the project is to determine if the higher temperature environment of an adiabatic diesel engine offers any new potential for utilization of coal in piston engines. To meet the overall objective, the project has three specific goals. They are to: determine the ignition and combustion characteristics of three coal slurries in an adiabatic diesel engine and compare to a baseline diesel fuel; compare the ignition and combustion characteristics of the slurries in the adiabatic engine to those observed in a similar, but conventional, diesel engine and compare with the baseline diesel fuel; and obtain preliminary data using a dry-powder coal injector in both the adiabatic and conventional test engines. The combustion characteristics of three slurries; coal/water, coal/methanol, and coal/diesel are evaluated in two different engines. Dry coal powder will also be tested in the same engines. The engines are basically the same configuration, but one is liquid cooled, and the other has ceramic coated parts which are uncooled. Results are discussed. 8 references.

10817 (DOE/METC—86/6041, pp 285-294) **Combustion of coal/water slurry fuels in conventional diesel engines.** Zimperman, R.A. (Energy and Environmental Research Corp., Irvine, CA). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21100.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

This program addressed the potential for utilizing coal slurry fuels in conventional or minimally-modified diesel engines. The major objectives of the program were to: investigate the potential for burning technically and economically viable coal slurry fuels in conventional diesel engines; develop an understanding of differences in the basic injection, ignition, and combustion characteristics of slurry fuels compared with diesel fuel and determine how these processes affect the utilization of slurry fuels; identify system modifications which may be required to obtain satisfactory performance with slurry fuels; and obtain engine performance data to verify operability. Results are discussed. The general conclusion of this study is that the conventional medium speed diesel engine is unsuited to the utilization of coal/water slurry fuels and that improvements must be implemented in the areas of fuel injection, ignition, lubrication system, and combustion chamber materials.

10818 (DOE/METC—86/6041, pp 295-307) **Advanced diesel research engine test facility for DOE Morgantown.** Hughes, M.P. (G. Cussons Ltd., Manchester, England). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-85MC22124.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

In order to provide support to the reciprocating power plant application sector of the DOE Heat Engines Program, the requirement was determined for the establishment of a suitable engine test facility within the M.E.T.C. site. It was envisaged that the role of this new facility would be to undertake practical trials of advanced fuel preparations, components and systems identified as a result of external research, together with the operation of selected independent development programs. The functional capabilities of the facility were required to allow advanced combustion diagnostic testing to be carried out in addition to the derivation of routine engine performance characterizations. Advanced combustion analysis by direct optical techniques and physical data measurements in cylinder are to be employed in the facility. This paper describes the selection of the test engine, auxiliary systems for coal-based research applications, test program on equipment, and diagnostic equipment.

10819 (DOE/METC—86/6041, pp 308-319) **Coal-fueled diesel: simulation study.** Caton, J.A. (Texas A & M Univ., College Station). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—). Contract AC21-84MC21175.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The overall objective of this work was to develop and use engine cycle simulations for evaluating the use of coal fuels in reciprocating engines. Specific objectives of this work were: to develop phenomenological combustion models for coal fuels in engine environments; to integrate the combustion models with two- and four-stroke cycle engine simulations; and to use the coal-fueled engine simulations to investigate the performance and combustion characteristics of coal fuels in reciprocating engines. Results to date are given and discussed. 9 references.

10820 (DOE/METC—86/6041, pp 320-334) **Numerical analysis of coal-fired diesel engines.** Gentry, R.A. (Los Alamos National Lab., NM). Aug 1986. NTIS, PC A16/MF A01. File Number DE86001086. (CONF-860535—).

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The goal of this effort is to develop a multidimensional computer program for the detailed transient analysis of a diesel engine fueled with coal slurry. This program will calculate the coupled in-cylinder gas dynamics, spray motion, slurry evaporation and devolatilization of the coal particles, char combustion, chemical reactions with accompanying heat release, and radiative heat transfer that occur in engine operation. The primary emphasis of the proposed work for FY 86 is to adapt the Los Alamos combustion dynamics program, KIVA, for analysis of coal-fired diesel engines and to begin application studies. The paper discusses the KIVA program, the slurry particle evaporation model, radiative heat transfer, coal devolatilization and char combustion, and chemical reactions. 21 references.

10821 **(DOE/METC—86/6047) Extractors manual for Fluidized-Bed Combustion Data Base System: Test Data Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Sep 1986. Contract AC21-85MC21353. 456p. NTIS MF A01; 2; GPO Dep. File Number DE86006551.

Fluidized-bed combustion (FBC) technology is rapidly emerging as an acceptable alternative to conventional coal-fired boiler technology. To satisfy the engineering public's need for experimental data and to assist in the study of technical uncertainties in FBC technology, the Department of Energy (DOE) has initiated the development of a data system to store the results of Government-sponsored research. To capture the results of Government-sponsored FBC research programs, documents have been written for the TDDB and MPDB to specify the data that contractors need to report and the procedures for reporting them. The FBC documents identify and define the data that need to be reported for FBC projects so that the data entered into the TDDB and MPDB will meet the needs of the users of the FBC data system. This document addresses what information is needed and how it must be formatted so that it can be entered into the TDDB for FBC. The level of detail needed to satisfy the wide variety of potential users' needs is the primary consideration in determining the types and amounts of data to be stored. The TDDB was designed so that data could be stored at any level of detail. 3 figs., 26 tabs.

10822 **(DOE/METC—86/6048) Extractors manual for Fluidized-Bed Combustion Data Base System: Major Plants Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Sep 1986. Contract AC21-85MC21353. 511p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE86006552.

Fluidized-bed combustion (FBC) technology is rapidly emerging as an acceptable alternative to conventional coal-fired boiler technology. To satisfy the engineering public's need for experimental data and to assist in the study of technical uncertainties in FBC technology, the Department of Energy (DOE) has initiated the development of a data system to store the results of Government-sponsored research. The FBC Data System consists of FBC data stored in the MPDB, TDDB, and MMDB; it will contain both atmospheric and pressurized FBC facilities. To capture the results of Government-sponsored FBC programs, documents have been written for the MPDB and TDDB to specify the data that contractors need to report and the procedures for reporting them. The FBC documents identify and define the data that need to be reported for FBC projects so that the data entered into the MPDB and TDDB will meet the needs of the users of the FBC Data System. This document identifies what information is needed and how it must be formatted so that it can be entered into the MPDB for FBC demonstration and commercial plants. The structure of the MPDB is shown in Figure 1-1. Section 2.0 describes the needs of potential users of the FBC Data System. Section 3.0 explains how the contractor should report and format this data so that it can be entered into the MPDB. Section 4.0 explains the quality control procedures that should be used to ensure the integrity of the data that is stored in the MPDB. 2 figs., 28 tabs.

10823 **(DOE/PC/70764—5-Pt.2) Effect of in-situ heat treatment on coal char reactivity. Final report, March 15, 1984-March 14, 1986. Part 2.** Shaw, D.W.; Essenhigh, R.H.; Bailey, E.G. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Jun 1986. Contract FG22-84PC70764. 247p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86012362.

A two-color pyrometer was designed, built, and used to measure char-particle temperatures in a flame. The pyrometer had water-cooled optical and background probes allowing local temperature measurement. A flat flame temperature profile was found, confirming the assumption of plug flow. The temperatures measured using the two-color pyrometer and a suction pyrometer were in close agreement. Significant temporal fluctuations were found in the measured temperatures. These were attributed to variations in temperature and obscured fraction of field of view. The temperature "excess" over the mean was found to be a monotonic function of the "excess" obscured fraction of field of view. 58 refs., 28 figs., 2 tabs.

10824 **(DOE/PC/70815—T7) Kinetics of coal combustion: Seventh quarterly report.** Gat, N.; Petach, M.; Gavalas, G.R.; Flagan, R.C.; Essenhigh, R.H. (TRW Space and Technology Group, Redondo Beach, CA (USA); California Inst. of Tech., Pasadena (USA); Ohio State Univ., Columbus (USA)). Oct 1986. Contract AC22-84PC70815. 51p. (TRW-SN—44617). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003353.

The objective of this investigation is to develop an improved comprehensive understanding of the kinetics of coal combustion relevant to suspension firing of powdered coal. The program is being carreid out by investigators from several institutions: TRW (prime contractor), Ohio State University (OSU), and California Institute of Technology (CIT), (both subcontractors). The investigation of fundamentals of coal combustion kinetics addresses several topics of major importance relative to improved understanding of pulverized coal combustion and includes both homogeneous and heterogeneous reactions. The principal topics include: (1) combustion of volatiles; and (2) heterogeneous combustion of coal/char. Research activities include small-scale experimentation, interpretation of experimental results in terms of mechanistic understanding, and the development of validation of kinetic models of fundamental processes. 9 refs., 20 figs., 4 tabs.

10825 **(DOE/PC/71504—6) Operation and maintenance of DOE/PETC Combustion Test Facilities: Quarterly technical progress report for the period July 1, 1986 to September 30, 1986.** (Gilbert/Commonwealth, Inc., Reading, PA (USA)). 1986. Contract AC22-85PC71504. 97p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87003564.

This technical report summarizes the progress made by Gilbert/Commonwealth, Inc. (G/C) at the Pittsburgh Energy Technology Center (PETC) of the US Department of Energy (DOE). The Alternate Fuels/In-House Research program includes the Residential, Commercial and Industrial Boilers/Furnaces programs. Progress in the Residential Boilers/Furnaces area included continuous-run baseline testing of the warm-air furnace and preparation for a future study on polycylic aromatic hydrocarbon (PAH) emissions. In the Commercial Boilers/Furnaces Area, baseline testing of the cast-iron boiler with No. 2 fuel oil and a rotary-cup burner was performed. Work on the Industrial Boilers/Furnaces program focused on testing the commercial dense-phase pulverized-coal (PC) transport system and experimental PC burner with coals of various particle sizes. Progress in the Flue Gas Cleanup Research and Development program included successful spray dryer operation in both the Dry Injection Process PDU and the 500-lb/hr PC combustion facility. An additional task was the reactivation of the Copper Oxide Continuous Life Cycle facility. In Advanced Separation Techniques, work advanced to the point where tests were performed on the absorber/stripper column. In the Advanced Research and Technology Development program, preparation of the laser diagnostics laboratory continued. The coal flow loop was reactivated for Solid-Gas Transport studies. A final report was written describing the status of the Improved Lock Hopper Design. The drop tube reactor was received, and preparation of the Global Char Combustion Kinetics test facility neared completion.

10826 **(DOE/PC/80528—T6) Group combustion of coal particles: Quarterly progress report, September 16, 1986 to December 15, 1986.** Annamalai, K. (Texas A and M Univ., College Station (USA). Dept. of Mechanical Engineering). 15 Dec 1986. Contract FG22-85PC80528. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003363.

Figure 2 plots the cloud radius (R) vs time (t). The plot for G = 0.1 (dilute cloud, DL) shows a steep slope. This can only happen if all the particles almost burn simultaneously, which confirms the individual particle combustion (IPC) mode. Thus we can conclude that the combustion regime for G = 0.1 is in IPC mode. As for G = 100 (dense cloud, DS), we see that the reduction of cloud radius is slower and thus the cloud takes a longer time to burn out. It can be noted that the cloud radius is a linear function of time once combustion starts at 1.3 secs. The time taken for the start of combustion is very long for G = 100 and also that the cloud burns slowly. It should not be misinterpreted that the cloud with G = 100 has a lower burning rate. Actually, the burning rate of DS is more than for DL, since there are more particles burning at a given time a in bulk cloud. The particles take a longer time to burn because of oxygen concentration in the bulk gas phase is very low and many times combustion is limited by diffusion of O_2 to the cloud periphery (sheath combustion mode, SC). The plot of R^2 vs t confirms these results. As the particle gets smaller the diffusion of oxygen to the particle is increased as the mass transfer coefficient h/sub m/ is inversely proportional to the particle diameter. Thus the particle no longer burns under diffusion control and so the burning may be kinetically controlled for the interior particles. Their rate of burning is limited by diffusion of O_2 to the cloud periphery. 8 figs.

10827 **(DOE/PC/80752—T6) Detailed model for practical pulverized coal furnaces and gasifiers: Quarterly technical progress report no. 5 for the period 1 August 1986 to 31 October 1986.** Smith, P.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 30 Nov 1986. Contract FG22-85PC80752. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003407.

On May 1, 1985, work was initiated on a contract sponsored by a consortium of industrial and governmental agencies aimed at development of a practical, 3-D coal combustion model. The general objective of this study is to improve and extend a generalized

two-dimensional, pulverized coal combustion and gasification code for application to large-scale, practical configurations, and to evaluate and implement the resulting code on an industrial scale. This report summarizes work conducted during the second quarter of the second year (sixth quarter) of this contract. A summary of work accomplished during this quarter is given by task and includes only tasks worked on during this quarter.

10828 **(ECN—86-040) Reactivity of inertinite and coke in recycling fly ash in FBC.** Vleeskens, J.M. (Netherlands Energy Research Foundation, Petten). Mar 1986. 19p. (In English and French). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the meeting Petrographie et Industrie, Verneuil-en-Halatte, France, 25 April 1986.

The composition of unburnt residues of fluidized bed combustion changed during recycling of the fly ash. It has been observed that the amount of inertinite with respect to coke gradually diminished as the recycle ratio increased till the carbon loading of the reactor was 30% recycled material. Coke formation, rather than the presence of inertinite, decreases coal reactivity and effective burnout at 850°C. 2 refs.

10829 **(NZERDC—133) Alternative coal combustion systems: [Final report].** Martin, C.G.; Johnston, K.C. (New Zealand Energy Research and Development Committee, Auckland; Martin (C.G.), Christchurch (New Zealand); Murray-North Partners Ltd., Auckland (New Zealand)). Aug 1986. 102p. NTIS (US Sales Only), PC A06. File Number DE87900432.

This report reviews the state of the art of systems used for coal combustion, as applicable to the scale of New Zealand industry. Very large utility power station boiler plants are not considered. Combustion systems are classified by the arrangement used to bring the fuel and combustion air into contact, namely: fixed and moving grates with under, over and sideways feed of coal; fluid bed reactors of the "bubbling" and "fast" types; entrained reactors using pulverized coal; and cyclone reactors. Each type of combustor is considered as part of the total combustion system consisting of reactor, fuel feeding and metering means, ash and clinker removal means, and means for control of atmospheric pollution by the exhaust gases. The heat user and heat transfer system are not considered other than directly in relation to their effect on combustion. Current New Zealand practice is reviewed critically, based on a large sampling survey of coal-using plants, and searches of the literature including the International Energy Agency database. A summary of the New Zealand survey, which included visits to plants using in total over half of the coal burned in the country (excluding utility power stations), is given as an appendix. A number of relevant original computer programs covering combustion stoichiometry and flue gas cleaning are appended. 35 refs., 29 figs., 18 tabs.

10830 **(VTT-TIED—573) Combustion of low calorific gas.** Holopainen, T.; Hyvoenen, P.; Asplund, D. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 71p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750647.

The use of low calorific gas is heavily dependent on the availability of a suitable burner. This literature review presents information on burner technology of low calorific gas and also includes experimental results from other laboratories. The presence of contaminants such as tar, char, and ammonia will increase the NO/sub x/ emissions above that expected due to thermal NO/sub x/ production alone. Research conducted by the Institute of Gas Technology confirmed the expected result that ammonia is the main contributor to this NO/sub x/ production. IGT experienced stability problems when using low calorific gas with turbulent diffusion flames such as found in kilns. No stabilization problems were experienced using a boiler burner, wherein air and gas mixing is very effective. Sod peat gasification holds many inherent advantages, but before they can be fully realized the problems of controlling the combustion of low calorific gas and limiting NO/sub x/ production must be researched. The solution to these problems will not be a simple one; a compromise must be made between flame control and NO:x emissions. The tradeoffs are dependent on the type of burner used, the quality of gas produced, and the boiler conditions.

10831 **(VTT-TUTK—409) Costs of district heating plants using wood and peat fuels.** Miettinen, M.; Hallikas, J.; Asplund, D. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 59p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750644.

A mathematical model has been developed for estimating the costs of district heating plants. Actual cost data have been obtained from heating plants and equipment manufactures. The data have been classified and analyzed to determine cost factors and capacity exponents. The mathematical model has been made for estimating the investment costs and operating cost of energy production based on cost factors. The investment costs are estimated as a function of plant capacity at two precision levels. The investment costs of a plant are estimated based on the costs of the main equipment and cost factors with a rapid estimation method. In the more detailed method the most important equipment, like combustion chamber and boiler have been specified according to their components. The investment costs have been divided into labor and material costs. Cost factors and cost accounting of engineering works are included in this cost estimating method. This method can be used to study the cost effects of different technical solutions on costs. The investment costs and costs of heat production in heating plants of different sizes are presented as an example. Analogously, cost comparisons and profitability calculations can be made with the model regardless of different fixing of prices by equipment manufactures. Cost estimation will be developed by collecting further actual cost data of other equipment and larger capacity area.

10832 **Entrained coal combustor promises low emissions of nitrogen oxides.** Bauer, J.M.; Roy, G. *Materials and Components in Fossil Energy Applications;* No. 63, 4-5(1 Aug 1986).

An entrained-flow coal combustor is under development for use in retrofitting boilers, direct coal-fired gas turbines, and magnetohydrodynamic power generation by TRW. While cyclone-type combustors are familiar in steam boiler applications and are widely applied on Babcock and Wilcox (BW) units installed up to the late 1970s, there are major differences between the BW burner and the TRW design. The TRW cyclone burner is essentially a water-cooled cylinder into which pulverized coal is injected axially from one end and is mixed with preheated air which is admitted tangentially. Ash in the coal is converted into droplets of molten slag which are deposited on the combustor walls. The aerodynamic forces and the arrangement of the baffle within the cyclone combustor are intended to result in trajectories for the slag particles which limit the size of gas-borne particles leaving the combustor to about 7μm. The operation of the combustor is discussed.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 11167, 11452, 11463

10833 **(DOE/EIA—0125(86/3Q)) Coal distribution, January-September 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 6 Jan 1987. 101p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. File Number DE87004097.

US coal producers and distributors shipped 665.3 million short tons of coal to domestic and foreign destinations from January through September 1986, 2.8 million short tons more than the amount shipped during the same time period of 1985. Nearly all (99.9%) of the coal that was produced and purchased during the first 9 months of 1986 was shipped. In contrast, shipments exceeded production and purchases by 1.6 million short tons during the comparable period of 1985 as producers and distributors drew from their stockpiles to help meet the demand. During January through September 1986: (1) Coal production was 0.7% higher and coal shipments were 0.4% higher than during the same time period of 1985. (2) Producers and distributors held stockpiles of 33.7 million short tons on September 30, 1986, 1.8% more than their stocks at the end of 1985. (3) Shipments for export were 7.8% less than they were 1 year earlier. (4) Domestic shipments to electric utilities and other industrial plants were higher while those to coke plants were lower, compared to the same time period of 1985. This issue contained a review article on Pennsylvania anthracite. 6 figs., 33 tabs.

10834 (EPRI-EA—4857, pp 15.1-15.23) **Western coal: an industry in transition.** Major, R.L. (Elk River Resources, Inc., Lakewood, CO). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

The changes in the perceptions about the future of the energy markets over the past four years are discussed. In retrospect, 1981 may have been about the peak of optimism in the energy and coal markets. The optimism about growing demand and the debate about how high energy prices would go have been replaced by a reassessment in the face of dramatically different market conditions. Slower economic growth, lower growth in coal demand, and falling prices have changed the outlook for western coal. The combination of pro-coal factors which formed the basis for the rapid growth in the western coal production over the past 15 years as well as the basis for projections for rapid growth in western coal in the future have changed significantly. The historical development of the recent coal boom, the changes which are occurring, and their implications for the future are discussed.

10835 **(IEA/ICEAS—D3) Marine transport costs and coal trade.** Doyle, G. (International Energy Agency Coal Research, London (UK)). Aug 1986. 82p. NTIS, PC A05/MF A01. File Number DE87900392.

In normal market conditions the long-run average costs will be below the fully build-up costs of new vessels but above the costs for a large section of the old fleet. Trade patterns may in practice be robust, since several factors act to reduce the sensitivity of trade to changes in relative cif prices. Quality 'lock-ins', favored nation purchases, joint ventures tie-ups and rigid long-term contracts all imply a degree of purchaser loyalty. But perhaps of more importance is the fact that coal buyers tend to diversify purchases in order to insure against the costs of supply disruptions and price hikes. Variations in the general level of marine transport costs are seen to play a minor role in influencing trade. The most important factors in determining coal trade are buyers' preference structures (particularly their risk management strategies), supply cost and availabilities and demand configurations. Variations in marine transport costs will clearly feed through of cif costs; however, given that the share of these costs in total cif costs is generally less than 25% in the main demand centers, the impact should be slight. It is the supply and demand configurations which are crucial in determining cif prices. Vessel size is also not expected to be very sensitive to variations in freight costs since most coal trade is likely to be direct trade - transhipping is likely to play only a modest role. Port capacity, buyer parcel-size preferences and the potential for multi-porting operations will be the primary determinants of vessel size. Regional differences in ports' abilities to handle large vessels, the differences in suppliers' comparative advantage across parcel-sizes mean that geographical concentration of fleet sectors is to be expected. 58 refs., 10 figs., 49 tabs.

10836 **(TKK-F—546) Long term planning model for the Finnish energy supply system. Application 1: consequences of alternative peat price developments.** Myllyvirta, J.; Routti, J.; Pirilae, P. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1984. 27p. (In Finnish). Helsinki University of Technology, Otaniemi, Finland.

Two different price scenarios for peat are analyzed using the long term planning model KETO A, which describes the Finnish energy supply system divided into six regions. A reference scenario with constant prices for all fuels is also included. The objective is to evaluate the influence of the price of peat on the energy system till the year 2010. The price of peat affects the use of peat primarily in district heating and also in industry. Peat competes with coal, and their price ratio is the most important parameter in the question. According to the results obtained, the use of peat in 2005 could vary between 19 and 38 TWh/a, even for moderate differences in the price ratio. The results of the model give a rather detailed estimation of the peat use in various sectors of the energy supply. The model with its regional characteristic fits well to the analysis of the use of solid fuels. The accuracy of the results could, however, be significantly improved through application of specific modifications to the model structure and input data.

0160 Health And Safety

10837 **(PB—87-106191/XAB) Development of the capacity to assess occupational noise overexposure in the mining industry. Open File report.** Galaitsis, A.G. (BBN Labs., Inc., Cambridge, MA (USA)). Feb 1986. 206p. NTIS, PC A10/MF A01.

The purpose of the work was to expand and improve the scope and accuracy of the method developed for the prediction of the number of workers overexposed to noise in the mining industry. A significant portion of the noise data were acquired during mine visits that took place in the course of this study. These data were obtained with time-resolved dosimeters, which among other things store a time history of the sampled noise for an 8-hour work period. The remainder of the noise data have been obtained from MSHA files and from other Bureau of Mines projects. The report reviews the prediction model, discusses the model's assumptions and approximations, describes the function of the developed software, offers typical examples on the use of the software, and includes plots of the newly acquired noise data records.

10838 **Identification of mutagenic constituents in coal-combustion flyash.** Wilson, B.W.; Chess, E.K.; Later, D.W.; Harris, W.R.; Okomoto, D. (Battelle Pacific, Northwest Laboratory, Washington, DC (USA). Biology and Chemistry Department). pp IV/81-IV/92 of Fluidized bed combustion and applied technology - the first international symposium. Schwieger, R.G. (ed.). New York, NY; Hemisphere Publishing Corp. (1984). (CONF-830824—).

From 1. international fluidized bed combustion and applied technology symposium; Beijing, China (22 Aug 1983).

Also published by McGraw-Hill Publications Co., New York, NY, USA.

Presents data on the characterization of several high molecular weight nitro polycyclic aromatic compounds which are major constituents of mutagenically active subfractions in organic extracts of fly ash from conventional pulverized coal combustion (PCC). Compounds found in mutagenically active fractions of PCC fly ash were compared to those found in active fractions of fly ash from an experimental fluidized bed combustion (FBC) unit. Several methods have been used to identify nitro-PAH and oxygenated PAH present in both the FBC and PCC particulates, including instrumental analysis and selective biological techniques. This paper deals mainly with the chemical characterization of these materials and the instrumental analysis methods used to achieve the characterization. The biological techniques, including mutagen screening using Salmonella typhimurium, are discussed briefly. 12 refs., 5 figs., 1 tab.

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 10769

10839 **(CONF-8511245—Pt.4) Development prospects for North Norwegian waters. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750639.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains two papers covering: Development possibilities in the Haltenbanken/Troms area; The U.S. LNG market. The need for marketing flexibility. Separate abstracts were prepared for both papers of the section.

10840 (CONF-8511245—Pt.4, pp A14 1-11) **Development possibilities in the Haltenbanken/Troms area.** Bergseth, S. 1985. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750639.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

In both Haltenbanken and Tromsoeflaket, in the Norwegian Sea, promising fields have been discovered. Of the three most important fields at Tromsoeflaket, two are typical gas fields, while the third one is a gas field with an oil leg. The gas resources at Tromsoeflaket do not seem likely to be developed on a short-term basis with the traditional technology. However, some type of pilot production should not be completely disregarded. Six fields have been discovered so far in the Haltenbanken area. They can be classified in three categories, based on the gas/oil ratios of the various fields. Two of them are typical oil fields with limited quantities of associated gas. The characteristics of the Haltenbanken fields call for a coordinated development in the area. If the incentive offered through a joint pipeline system is sufficient, the system should be implemented together with the first field to be developed. Development and research based on development schemes applied in the North Sea will provide the required technology for developing the first fields within a few years.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 10843, 12321

10841 **(CONF-8511245—Pt.3) High tech solutions for future North Sea exploration and exploitation challenges. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 136p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750638.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains four papers covering: Geophysical applications for the future; Extended reach drilling applications in the North Sea; Fracturing in Valhall chalk; Future deepwater development. Separate abstracts were prepared for two papers of the section.

10842 (CONF-8511245—Pt.3, pp A10 1-34) **Geophysical applications for the future.** Kjellesvik, S. 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750638.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

Geophysical methods used in exploration include a number of various techniques. As the seismic method is GECO's original and still most important activity, the paper is focusing on the development of this technique until today, and thoughts about the future. Traditionally, the seismic method is divided into three categories: acquisition, processing and interpretation. The increased data volume and interactive use of computers are essential for both present day and future technology in all three categories. Examples are shown and data presented for each of the three categories. The present day three dimensional data acquisition and use of multisource and multistreamer are described. For the acquisition and processing phase the data volume is described, and it is demonstrated how the use of super computers in three dimensional prestack migration in the future will improve the seismic method as a tool for geologic mapping. It is shown how the interactive use of computers in the processing and interpretation phases will become increasingly important in the future. Parallel to the interactive use of computers, elements from expert system concepts may assist the geophysicist in the sequence of data handling.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 10790, 10839, 10840, 10841, 10871, 11714

10843 **(CONF-8511245—Pt.1) Reservoir management. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750636.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains three papers covering: Key elements in maximizing Statfjord field reservoir performance; Reservoir management considerations in the Frigg field; Ekofisk- reservoir in a compacting environment. Separate abstracts were prepared for two papers of the section.

10844 (CONF-8511245—Pt.1, pp A3 1-22) **Key elements is maximizing Statfjord field reservoir performance.** Harper, R.H. 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750636.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

The Statfjord field, discovered in 1974 in the North Sea, is the most prolific oil field in Europe. The field's size and recovery potential have warranted comprehensive reservoir studies targeted at maximum overall efficiency and performance. Alternative strategies for production were developed long before the field went on stream in 1979. As early as 1975, a study on a two-dimensional computer simulation model indicuted a three-platform development with annual offtake rates of 6 to 10 % of recoverable reserves sales were already highlighted at that time. In October 1979 the first full-field, full-life study of Statfjord on a new three- dimensional, three-phase simulation model was completed. A gas sales evaluation in 1980 updated this study and indicated that gas sales would be required in 1985 to avoid overpressuring the Statfjord reservoir. Reservoir management progressed with new models which included history matching of reservoir pressure, gas-oil ratio performance and water-cut performance. The Statfjord field development plan illustrates the use of reservoir simulation in early development planning and ongoing reservoir management. Successful reservoir management however, depends not only on extensive modeling, but more importantly on data acquisition and sound data analysis. In the case of Statfjord, this has meant the application of the basic disciplines of production geology, reservoir engineering, and production engineering in an integrated team approach. This integrated reservoir management team is viewed as being a key element in maximizing performance of the Statfjord field.

10845 **(CONF-8511245—Pt.2) Major North Sea projects at different stages. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 106p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750637.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains four papers covering: Development of the Gullfaks production organization; Oseberg field development parameters; Snorre - organization and resource basis; Snorre - a new trend? A separate abstract was prepared for one paper of the section.

10846 (CONF-8511245—Pt.2, pp A7 1-19) **Oseberg field development parameters.** Enger, T. 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750637.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

The Oseberg field is located in the North Sea, some 100 km off the western coast of Norway, and the water depth in the area is about 100 m. The production start-up is set for April 1989. The main criteria for the selection of the most optimal field development concepts are: (1) Optimal recovery of hydrocarbons. Extensive simulation studies have been carried out to determine the optimal reservoir production strategy. The result is that production of oil will start with injection of associated gas and water for pressure maintenance. When the oil production period is over, the field will produce gas. (2) Requirements to safety and work environment shall be met. This shall apply over the whole life of the field (a design life of 4 years has been used). (3) The total field economy should be optimized with regard to production profile, investment and operating costs, and production regularity. (4) Economic exposure and risk should be minimized. The various development concepts should be evaluated in terms of economic exposure and risk with respect to cost overruns, schedule delays and production reliability. As a means of reducing this risk, it was early established that the Oseberg development should be based on proven technology. (5) Flexibility for future development in the area. The Oseberg field is located in a promising area for future oil discoveries. Some

flexibility should be included in the design for tying in other fields and utilizing the Oseberg infrastructure for further developments.

10847 (CONF-8511245—Pt.3, pp A11 1-30) **Extended reach drilling applications in the North Sea.** Tolle, G.; Dellinger, T. 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE87750638.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

Extended reach drilling (ERD) is an integrated methodology for drilling high-angle wellbores with long horizontal displacements. The combination of long hole sections and inclinations greater than 60 degrees causes problems due to gravity, friction and particle settling, which must be overcome in order to successfully drill an ERD wellbore. Recognizing the need to develop ERD expertise, Mobil technologists began to identify and refine ERD concepts in 1977. The effort was essentially complete in 1979 and resulted in a proposal for a full-scale field test. The proposal was submitted to the industry, and Mobil was joined by seven other oil companies as project participants, with Mobil as operator and administrator. The disclosure of results from the field test to non-participants is prohibited by the terms of the Agreement between the ERD participants. Generally, the overall success of the ERD project may be inferred by the utilization of ERD technology by project participants and the close observation by non participants of ERD technology applications. Several examples of possible applications of ERD technology in the North Sea present broad scenarios, which are intended to demonstrate the economic and operational benefits of ERD wellbores. It is claimed that if ERD technology had been available in 1974, the development of the Statfjord field, from a drilling standpoint, might have been accomplished with two platforms instead of three. Possible applications of ERD technology can be made to protect environmentally sensitive areas, reduce a required number of well completions and develop additional reserves.

10848 **(CONF-8511245—Pt.5) Industry perspectives and challenges. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750640.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains four papers covering: Norwegian industry capacity and capability; Subsea development applications offshore Norway; The Poseidon project; The new generation of offshore construction vessels. Separate abstracts were prepared for three papers of the section.

10849 (CONF-8511245—Pt.5, pp B1 1-24) **Norwegian industry capacity and capability.** Glad, K. 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750640.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

The paper focuses on the question of what new technology, products, production methods and organizational structures are needed to help keep future development on the Norwegian shelf profitable. Factors like innovatory design concepts, revised organization and contract models, and the increased use of computer-based design and information handling methods are specifically mentioned. Other areas where further research and development programs will have an impact on the profitability of developing fresh offshore fields, include more use of two-phase flow, an increasing in drilling deviation angles and even driving tunnels beneath the seabed. Similarly, advances in materials technology and more standardization of product specifications and codes could make an important contribution to cost savings.

10850 (CONF-8511245—Pt.5, pp B2 1-10) **Subsea development applications offshore Norway.** Quenild, R. 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750640.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

The current status of subsea systems, particularly those considered for the Norwegian sector of the North Sea, is approaching a level of acceptability similar to that for conventional platform systems. This trend is reinforced by the increasing number of subsea developments under evaluation by North Sea operators, guaranteeing the more widespread utilization of subsea completed wells for both economically marginal, shallow and deepwater hydrocarbon deposits. Major Norwegian subsea projects, past, present and future, have been reviewed with particular emphasis given to those areas in which innovative technology has been introduced. Diverless subsea systems feature significantly in the latest field development plans with an increasing emphasis upon utilization of modularized systems to simplify equipment replacement and improve overall system reliability.

10851 (CONF-8511245—Pt.5, pp B3 1-15) **POSEIDON project.** Fabiani, P. 1985. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750640.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

POSEIDON is a new offshore production system, particularly geared to the development of offshore fields situated in severe environments (deep waters, rough seas, etc.) well away from the coast (up to several hundred kilometers). The main features of POSEIDON are: (1) All permanent equipment and facilities are underwater, without any fixed or floating platform supporting the operations; (2) These equipments and facilities are drastically reduced by means of polyphasic boosters which pump all the production to shore through one single pipe line, and no processing is done on the site; (3) The level of safety is intrinsically improved, since most of the exploitation is moved ashore, in far safer and far more convenient conditions; (4) Investment costs as well as operating costs could be significantly cut back, as much as half; (5) One of the most interesting features of this project is that it is an international venture between three partners (IFP, STATOIL and TOTAL), equally sharing finance and work.

10852 **(DOE/BC/10830—4) A review and statistical analysis of micellar-polymer field test data: Topical report.** Lowry, P.H.; Ferrell, H.H.; Dauben, D.L. (Keplinger Technology Consultants, Inc., Tulsa, OK (USA)). Nov 1986. Contract AC19-85BC10830. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001202.

A statistical analysis study has been made of 21 micellar-polymer field test projects to evaluate the significance of key parameters upon performance. In this study, the term micellar-polymer is used to describe surfactant recovery processes of which the most common are the water phase low tension and the soluble oil.The micellar slug is usually followed by a drive slug containing a polymer for mobility control. The data include 10 projects that were used in a previous study and 11 other documented projects which have been completed recently. The study indicates three significant correlations. The most important of these is the correlation showing that oil recovery is inversely related to the log of the reservoir connate water salinity. This suggests that prior flooding with a water near the design salinity or use of preflushes to adjust salinity and remove hardness have, at best, been only partially effective. Exxon was successful in their second Loudon pilot when using a specifically designed salt tolerant surfactant, with no preflush. The results of this study, coupled with the results of the Exxon second Loudon pilot, suggest that future research in micellar-polymer flooding should focus on the development of surfactants which can tolerate the connate water salinity and hardness in the reservoir. A second correlation showed that oil recovery increased as the pattern size was decreased. This is attributed to the higher frontal velocities and to the reduced tendency of slug breakdown in smaller patterns. Low oil cuts at the beginning of the micellar-polymer floods indicated that higher recovery efficiency could not be attributed to infill drilling. The third correlation showed the expected results that oil recovery is related to the quantity of surfactant used. This quantity is the product of the surfactant slug volume and the concentration of surfactant. 71 refs., 4 figs., 2 tabs.

10853 **(EPRI-AP—4827) Coproduction of carbon dioxide (CO_2) and electricity: Final report.** Snyder, W.G.; Depew, C.A. (Fluor Technology, Inc., Irvine, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 154p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920143.

This screening study is an evaluation of the economics of coproducing electricity and CO_2 for enhanced oil recovery applications in a coal gasification-combined-cycle (GCC) power plant. Two plant designs, requiring only minor modifications to Texaco-based GCC plant designs reported in EPRI AP-3486 were developed. One design ("Minimum CO_2 Production") recovered CO_2 from the gasifier effluent, while the second design ("Maximum CO_2 Production") used shift conversion to increase CO_2 volume and partial pressure prior to CO_2 recovery. The CO_2 is dried and compressed to 2000 psig. The revenue required for CO_2 coproduction was calculated by crediting the electricity produced in each coproduct plant with the revenue requirements for the electricity-only GCC plant upon which each design was based. The levelized cost of producing CO_2 was calculated to be $0.64/MSCF and $0.85/MSCF for the Maximum CO_2 Production and Minimum CO_2 Production designs, respectively. 1 ref., 27 figs., 35 tabs.

10854 **(NIPER—173) Screening and laboratory flow studies for evaluating EOR [enhanced oil recovery] methods: Topical report.** Goodlett, G.O. Jr.; Honarpour, M.M.; Sarathi, P.; Chung, T.H.; Olsen, D.K. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Nov 1986. Contract FC22-83FE60149. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001203.

Numerous steps are involved in evaluating enhanced oil recovery (EOR) methods for field application. Technical screening guides should be consulted for initial determination of applicability, followed by a comprehensive analysis of fluid, rock, and rock-fluid interactions. Before displacement studies, decisions concerning type of core, core size, and experimental apparatus are made considering scaling laws, dispersive effects, duplication of reservoir conditions, and the unique parameters of the particular EOR method being considered. Experimental flooding techniques and interpretation of subsequent results for each type of EOR method are discussed in this report. EOR methods discussed include polymer flooding, surfactant-polymer flooding, alkaline flooding, thermal, and miscible and immiscible gas displacement. The critical flow study parameters are considered for each method. What can be learned from each type of coreflood experiment is described, and limitations are given. Specific techniques used in carrying out each type of coreflood experiment are presented. The coreflooding aspects of emerging EOR technologies, such as microbial methods and emulsion blocking in steamflooding, are examined. 82 refs., 15 figs., 12 tabs.

10855 **(NIPER—180) Using micromodels to study steam displacement processes in porous media: A literature review and topical report.** Sarathi, P. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Oct 1986. Contract FC22-83FE60149. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87001201.

Micromodels have been successfully used to observe various displacement processes at low temperatures and pressures and to understand fluid transport mechanisms within porous media. Previous research on physical pore model studies was reviewed, and the advantages and limitations of various techniques used are discussed as well as techniques used in the design, construction, and operation of the models. Finally, the possible use of micromodels to study the fluid displacement process at high temperatures and moderate pressures, such as those commonly encountered in steamflood enhanced oil recovery projects, was examined. An experimental system for studying high-temperature displacement processes in micromodels is discussed. Although no attempt to date has been made to investigate steam EOR processes in micromodels, experiments in micromodels at elevated temperatures should provide qualitative information on the effects of temperature on important process variables. 77 refs., 2 figs.

10856 **(NIPER—213) Transformation of hydrocarbons by microorganisms: Topical report.** Bryant, R.S. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Nov 1986. Contract FC22-83FE60149. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004136.

An increase in the number of microbial enhanced oil recovery projects in petroleum reservoirs has led to a heighted concern about the possible adverse effects that microbial metabolism may cause. One potential problem is the possibility of microbial metabolism on hydrocarbons in the reservoir, which might lead to undesirable alteration in the crude oil. This topical report addresses the microbial activity on hydrocarbons, with an emphasis placed upon considering the possible environmental hazards that the application of microbial petroleum technology may cause. From our analysis of existing data there is no proof that microorganisms have caused compositional changes in crude oil in petroleum reservoirs. There are a multitude of microorganisms that can metabolize crude oils aerobically, but there are no available anaerobic metabolic pathways for microorganisms to alter crude oils in the reservoir, where only anerobic conditions would exist. Certainly the advent of high technological processes could show that anaerobic degradation of petroleum by microorganisms can occur; however, at this time there is little chance of microbial anaerobic degradation occurring from microbial enhanced oil recovery processes. 40 refs., 4 tabs.

10857 **(NMRDI—2-74-4806) The potential of enhanced oil recovery by carbon dioxide flooding in New Mexico: Final technical report.** Brashear, J.P.; Becker, A.B.; Dowd, W.T.; Biglarbigi, K.; Crawford, P.M. (Interstate Oil Compact Commission, Oklahoma City, OK (USA); New Mexico Univ., Albuquerque (USA). New Mexico Research and Development Inst.). Dec 1986. 175p. NTIS, PC A08/MF A01 - NMRDI, Suite M, 457 Washington SE, Albuquerque, NM 87108. File Number DE87900413.

This report examines the potential of carbon dioxide miscible flooding in New Mexico to increase oil reserves and production, state and local revenues, state economic activity, jobs and wages, gross domestic product, and federal revenues. Using models and data bases built for the National Petroleum Council's study of enhanced oil recovery, 97 New Mexico reservoirs were evaluated to determine the potential of carbon dioxide flooding at prices from $16/B to $40/B, minimum rates of return of 10% and 15%, and three tax treatments: current taxes and two incentive cases (relief from income and production taxes for the life of a project or until project payback). The results show that at prices beginning at $20/B, substantial new reserves and production can be gained if tax incentives to payback are available, yielding substantial benefits to the state up to about $30/B. Beyond that price, incentives could be counter-productive to the state. Incentives can be administered through the use of a simple, readily measured ratio to determine approximately when payback occurs to minimize the administrative burden. With carefully designed incentives and oil prices in the $24 to 28/B range, New Mexico's oil production and oil-based taxes could be sustained at near current levels well into the next century. 45 figs., 9 tabs.

10858 **(RF-T—46/84) North Sea production and pipeline systems. Overview of existing and future installations on the Norwegian Continental Shelf.** Brekke, K.M. (Rogalandsforskning, Stavanger (Norway)). Oct 1984. 92p. NTIS (US Sales Only), PC A05. File Number DE87750634.

Initially, the division of the Norwegian Continental Shelf into zones, areas and fields is described. Thereafter, a brief description is given of each installation in each field. This is also attempted for fields which are not yet developed, but where development plans exist. Each installation is described with its function, start of production, number of wells, number of process trains, maximum daily design production capacity, etc.

10859 **(RF-T—47/84) Offshore production availability methods.** Aven, T.; Vaurio, J.K.; Oesteboe, R. (Rogalandsforskning, Stavanger (Norway)). Dec 1984. 97p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750633.

The object of the report has been to perform an availability study and a preliminary evaluation of model features required to develop an integrated production availability computer model. This report focuses on top-level throughput-availability methodology. A summary of througput-availability studies on production systems is given. An analytical and a Monte Carlo simulation approach are studied in detail. Possible modifications and extensions of the two approaches are discussed. The analytical approach has been most thoroughly analyzed. This approach is based on multistate flow network modeling. The trade-off between analytical and simulation techniques will be a matter of analysis purpose and level in ques-

tion, time and developing costs. Recent developments in reliability models and methods for components and systems have been studies and can be applicable on a more detailed analysis level to give pre-analyzed information to the top-level analysis.

0204 Processing

REFER ALSO TO CITATION(S) 10876

0205 Products And By-products

REFER ALSO TO CITATION(S) 11579

10860 (AD-A—172183/6/XAB) Antimisting-fuel research and development for commercial aircraft. Final summary report. Yaffee, M.L. (Federal Aviation Administration, Atlantic City, NJ (USA). Technical Center). Apr 1986. 100p. (DOT/FAA/CT—86/7). NTIS, PC A05/MF A01.

This report covers the research, development, testing, and evaluation conducted by the Federal Aviation Administration in pursuit of an effective, feasible antimisting agent for kerosene jet fuels that would prevent or reduce the dangers of postcrash, fuel-mist fires. For the past eight years, most of this effort was focused on a high-molecular-weight polymer, FM-9, as a representative agent to prove the antimisting-fuel concept. The results of this work indicate that the goal is achievable: Jet fuel can be modified to provide a significant degree of protection against postcrash fires in impact-survivable accidents. Additional development and testing would be required before the fuel is operationally acceptable. It would be necessary to make some modifications in fuel-handling procedures and hardware in aircraft and at airports. But there appear to be no technically insurmountable problems.

10861 (AD-A—173385/6/XAB) Effect of fuel properties on injection characteristics of four different diesel injection systems. Interim report, October 1983-December 1985. Callahan, T.J.; Ryan, T.W.; Schwalb, J.A.; Dodge, L.G. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Dec 1985. 93p. (BFLRF—210). NTIS, PC A05/MF A01.

Four diesel injection systems were selected for evaluating the effects of fuel properties on diesel-spray characteristics. The selected injection systems were from the following Navy engines: the Detroit Diesel Allison 4-53T, the Detroit Diesel Allison 4-71TI, the Cummins NH-220, and the Westerbeke 4-108. Fuel properties which were examined were viscosity and specific gravity. The injection systems were operated on nine test fuels covering a broad range of viscosity and specific gravity. High-speed movies were taken of the fuels being injected into a high-pressure environment. Penetration and cone-angle data were reduced from the movies and used as a basis for fuel-to-fuel comparisons. In addition, drop-size distribution was obtained for the Westerbeke 4-108 injection system operating on four fuels with different viscosities.

0206 Health And Safety

REFER ALSO TO CITATION(S) 11433

10862 (DOE/EIA—0380(86/10)) Petroleum marketing monthly, October 1986. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Dec 1986. 154p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. File Number DE87004096.

This report gives information and statistical data about a variety of crude oils and refined petroleum products. The publication provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 10839, 10857, 11427, 11463

10863 (BNL—38875) Software description of the production of Lower-48 onshore oil and gas model. Benneche, J.G. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 318p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87003491.

The report documents the software of the Production of Lower-48 Onshore Oil and Gas Model (PROLOG), developed by the Energy Information Administration of the Department of Energy. The FORTRAN computer code is described, along with the input data and the output reports from the model. In addition a short user's guide is provided. This report does not provide a detailed description of the methodology behind the model, which can be found in referenced documents.

10864 (DOE/EIA—0109(86/10)) Petroleum supply monthly, October 1986. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 22 Dec 1986. 100p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. File Number DE87003895.

Summary statistics for January through November are given with percentage change from 1985 for production, consumption, trade, and supplies. (PSB)

10865 (DOE/EIA—0487(85)/1) Petroleum marketing annual, 1985: Volume 1. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 16 Dec 1986. 141p. NTIS, PC A07 - GPO. File Number DE87003786.

Statistical data on a variety of crude oils and refined petroleum products are presented in two volumes. This volume contains annual price, volume, and percentage statistics. The second volume is a compilation of final 1985 monthly crude oil purchase prices and percentage statistics and refined petroleum products sales statistics. Data on crude oil include the domestic first purchase price, the free on board (f.o.b.) and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for refined petroleum products include motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane. Volume 1 contains a cross reference guide to facilitate comparing tables in Volume 1 with those published in Volume 2 and in the "Petroleum Marketing Monthly" (PMM).

10866 (DOE/EIA—0503) Are petroleum futures prices good predictors of cash prices. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 18 Nov 1986. 36p. NTIS, PC A03/MF A01 - GPO; GPO Dep. File Number DE87003179.

This report presents a statistical analysis of the use of heating oil futures prices to predict heating oil cash prices. The data are based on futures prices quotes appearing in the final sections of major daily newspapers such as the Wall Street Journal, and monthly cash prices published by the Energy Information Administration (EIA). In general, the question posed by the title of this report can be answered by a qualified "yes," but only when using the very near term futures prices, and only when predicting very near term forecasts and estimating preliminary data. The major findings of this research can be summarized as follows: Using 1-month-out futures prices to estimate current price data provides generally good results. Futures prices more than 1 month out do not significantly add to this estimation procedure. In both "cost passthrough" and market equilibrium price models, again only the 1-month-out futures price adds significantly to the predictive power of the equations. Polynomial distributed lag models estimated with futures prices up to 6 months out are slighly more likely to display significant results for the more distant futures prices than the traditional regression models.

10867 (FRNC-TH—1881) OPEC-OECD. Market analysis. Oil flow. Mourad, G. (Paris-6 Univ., 75 (France)). 1982. 207p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE87750978.

After a presentation of the member countries of OPEC and the OECD, modifications throughtime in exchange between the two organizations are examined. Current balances of payment from 1970 to 1979 and changes in goods exported by the OECD to OPEC and in petroleum exported to the OCDE are analyzed.

10868 **(SAND—86-2773C) Key stimuli for oil price fluctuations.** Dugan, V.L. (Sandia National Labs., Albuquerque, NM (USA)). 1 Dec 1986. Contract AC04-76DP00789. 6p. (CONF-861241—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003029.

From International scientific forum on fueling the 21st century; New Orleans, LA, USA (1 Dec 1986).

World events affecting the prices and supply of petroleum from 1950 through 1986 are discussed. (PSB)

0208 Waste Management

REFER ALSO TO CITATION(S) 11190

10869 **(CONCAWE—8/85) Trends in oil discharged with aqueous effluents from oil refineries in Western Europe; 1984 survey.** De Roocker, A.; Origoni, G.; Pauluis, C.D.; Payne, F.G.; Schenk, P. (Concawe, The Hague (Netherlands)). Sep 1985. 12p. CONCAWE, Koningin Julianaplein 30, 2595 AA The Hague, Netherlands.

This report summarizes the information gathered in a 1984 survey of CONCAWE's Western European oil refineries' effluent water quantity, oil content and treatment processes. It compares the 1984 data with the results of previous surveys, and shows that the trend towards reduction of oil discharges continued during 1984, although crude throughput remained essentially at previous levels. The report shows that refinery water is now being more efficiently used and more effectively treated before discharge. Not only has the total quantity of aqueous effluents discharged fallen significantly, but the average oil content of the effluents has also fallen. Furthermore, it also shows that the ratio of oil discharged to oil processed has fallen by half since 1981. The report indicates that around 70% of the refineries now include biological treatment in their waste water treatment facilities.

0220 Transport, Pipelines, And Handling

10870 **(CONF-8511245—Pt.7) Transport technology. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 118p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750642.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains four papers covering: Tunnels for developing offshore fields; A new multiple flow- and control line bundle; Pipelines on irregular seabeds; Offshore loading systems for deep water. Separate abstracts were prepared for two papers of the section.

10871 (CONF-8511245—Pt.7, pp B10 1-15) **Tunnels for developing offshore fields.** Doerheim, M.K.; Rekdal, O. 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750642.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

The need for alternative field development solutions increases as the petroleum activity on the Continental Shelf is extended to greater water depths, exposed to more extreme environmental conditions, and the installations become larger and more complex. Tunnels as a part of a field development is one such alternative, that is being considered. It is believed that it is possible to construct tunnels from the shore of Norway underneath the seabed as far as 50-60 km in rocks of quality equivalent to that of the Troll areas. For a 50 km long tunnel the construction time is estimated to ca 8 years. One application of tunnels is to place a pipeline in a tunnel to overcome an otherwise complex shore approach for a conventional pipeline system. It is belived that it is possible to install and operate equipment for processing and transportation of hydrocarbons in the tunnels. This application is probably economically favorable for fields close to shore only. To develop equipment and methods for drilling of wells from a tunnel will require extensive efforts. The economical potential will be greatest when equipment for drilling of production wells is included.

10872 (CONF-8511245—Pt.7, pp B12 1-39) **Pipelines on irregular seabed.** Lund, S.; Gjertveit, E. 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87750642.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

From the Statpipe project in the North Sea a unique experience has been gained on the design and construction of pipelines on seabed with large irregularities of different types. The Statpipe pipeline system consists of 4 pipeline legs and totals 842 km subsea and 40 km onshore lines. Two pipelines are crossing the Norwegian Trench at about 300 m water depth. In the Statpipe project pre-lay intervention to prepare the seabed for pipelaying was only required for less than a 1 km rock outcrop section in the landfall area. The offshore pipelines cross large areas of pockmarks and iceberg ploughmarks. However, after an extensive design effort a routing was found which avoided pre-lay intervention and limited the post-lay intervention work. Grout bag supports were installed underneath the most severe pipeline spans as a temporary measure, while permanent span correction was performed by trenching and gravel dumping. The above methods proved adequate for the largest ploughmark spans with height under the pipeline up to 3.3 m (moranic material) and pockmark spans in soft soil with height up to 6 m (trenching only). For pipelines in landfall areas, where the seabed is highly irregular due to rock outcrops, various construction methods are at disposal. The Statpipe project used a subsea bridge to span the irregularities, while another pipeline project (Oseberg) is constructing a subsea floor tunnel for later pull-in of the pipeline through a sealing plug at an offshore point.

0230 Properties

REFER ALSO TO CITATION(S) 11819

10873 **(FRNC-TH—2092) Biodegradation of crude oil in sea environment by a mixed bacterian population.** Rambeloarisoa, E. (Aix-Marseille-2 Univ., 13 - Marseille (France)). 1983. 110p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750979.

Crude oil degradation by mixed bacteria is studied in a bioreactor. Bacteria are obtained from a marine area polluted by hydrocarbons. Influence of temperature, pH, oxygen, mineral salt concentration are examined to increase degradation rate and to reproduce in vitro conditions which are found in sea environment.

10874 **(FRNC-TH—2093) Photooxidation inhibitors for petroleum products.** Lamathe, J. (Paris-6 Univ., 75 (France)). 1983. 27p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750977.

This paper reviews in the litterature the use of antioxidants to overcome photooxidation of pretoleum products spilled in sea. Use of photosensitizers such as 1-naphtol could be interesting because if irradiation with 1-naphtol produces by contraction a slowing down of high boiling point petroleum product spreading, this phenomena could be use for oil layer recovery. But it is not certain that oxidation accelerating agents does not increase the formation rate of water-in-oil emulsion. 15 refs.

10875 **(FRNC-TH—2297) Study of adsorption kinetic of saturated hydrocarbons in hy zeolites, mordenites and ZSM5.** Perperas, V. (Poitiers Univ., 86 (France)). 1983. 83p. (In French). Poitiers Univ., 86, France.

Adsorption kinetics and diffusion coefficients of 4 hydrocarbons (n-hexane, 2-methyl pentane 2,4 dimethyl pentane and isooctane) are determined in zeolites HY, H mordenite and HZSM5. Structure, adsorbing properties and catalytic properties of these 3 zeolites are examined. Adsorption isotherms from 0 to 275°C under 0 to 150 torrs are determined by thermogravimetry. Diffusion kinetics is studied. 62 refs.

10876 **(NIPER—152) Detailed analysis of polar compounds in Wilmington gas oil and hydrotreated products: Topical report.** Sturm, G.P. Jr.; Green, J.B.; Tang, S.K.; Reynolds, J.W.; Yu, S.K.T. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Dec 1986. Contract FC22-83FE60149. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001205.

The feedstock and hydrotreated products from the 650 to 1000 F distillate of Wilmington crude were characterized by high performance liquid chromatographic separation procedures, routine chemical analyses, and spectroscopic methods including infrared gas chromatography/mass spectrometry and high resolution mass spectrometry. The hydrotreated samples were produced in a trickle bed reactor using a commercial catalyst at a hydrogen partial pressure of 1500 psig. Reaction temperatures were 375, 400, and 425 C; and the liquid hourly space velocity ranged from 0.5 to 1.5. Color, specific gravity, viscosity, sulfur content, and nitrogen content of the products decreased with increasing severity of hydrotreating. Reaction temperature was a more sensitive process variable than space velocity for the reaction conditions employed in these experiments. Stability tests on the feed and hydrotreated products showed mixed results. The less severely hydrotreated products produced more sediment than the feed, particularly at long storage times. Only the most severely hydrotreated products exhibited less production of sediment than the feed at all storage times. Weakly acidic compounds were the most resistant of the polar components to hydrotreating in these experiments. These compounds were primarily carbazoles, naphthenocarbazoles, dinaphthenocarbazoles, phenylcarbazoles, some structurally different nitrogen compound types, and weakly acidic oxygen compounds (probably aromatic ketones). The most prominent nitrogen compound type in the feed acid fraction (-21N Z-series, benzocarbazoles) was the fifth most abundant in the acid fractions from the two most severely hydrotreated samples. Within the various carbazole or pyrrolic benzolog compound types, the higher molecular weight, and thereby presumably more hindered, homologs were more resistant to hydrotreating. 10 refs., 38 figs., 15 tabs.

10877 **(NIPER—202) Techniques to determine particulates in liquid fuels. Status report.** Bhan, O.K.; Brinkman, D.W. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Sep 1986. Contract FC22-83FE60149. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002028.

The objective of the current study is to search for test methods and techniques which can be used for fuel contaminant detection possibly under field conditions. In this report, several techniques have been identified which hold promise for jet fuel contaminant detection under field conditions. Instrumentation currently available for the aforementioned application are discussed and recommendations are made. Out of the ten techniques described in this review, four techniques (light scattering, ultrasonic attenuation, laser light obscuration, and laser holography) seem to hold promise for detecting particulates, and to some extent water, in jet fuels. For most of the methods, off-the-shelf instruments are available. Almost all of the equipment available requires ac 110/220 V power; however, some of the instruments can be modified for dc voltage use. In addition, some of the instruments can be miniaturized for field use. 152 refs.

10878 **(NIPER—207) Data evaluation and technique development for analysis of JP-5 fuels. Status report.** Vogh, J.W.; Pearson, C.D.; Bhan, O.K.; Brinkman, D.W. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Sep 1986. Contract FC22-83FE60149. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002025.

An increasing number of problems are being experienced with the currently available jet fuels. These fuels can form solids, increase in peroxide number, corrosiveness, and develop color and high viscosity when stored. Antioxidants (hindered phenols) have been generally used to overcome storage instability in these fuels. The objectives of this project are: (1) develop methods for accurately monitoring antioxidant depletion and peroxide formation in JP-5 fuels; and (2) assess changes in chemical composition of fuels upon aging. The following two techniques were developed for determination of antioxidant concentration in jet fuels: (1) reverse-phase high performance liquid chromatography used in conjunction with an electrochemical detector; and (2) gas chromatography/mass spectroscopy with selective ion monitoring. Concentration of two commercially available antioxidants (AO-29 and AO-33 at 12 and 24 ppM levels in a JP-5 fuel) was monitored using these techniques. Jet fuel samples with and without antioxidants are currently being aged in an oven at 60 C. Samples are being withdrawn at regular intervals. The samples collected for up to 12 weeks of storage did not indicate any sign of instability; however, the peroxide number of the fuel sample without antioxidants added increased significantly with fuel aging. 2 refs., 5 figs., 2 tabs.

0250 Combustion

10879 **(STEV-FBA—86-8) Oil mixed with water. Investigation and combustion of cracked high viscous fuel oils.** Schoen, E. (Statens Energiverk, Stockholm (Sweden)). 23 Jun 1986. 137p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750627.

These investigations cover mainly the properties and burning characteristics of low sulfur heavy fuel oil with max 1% S that are used in typical Swedish plants in the range 5-50 MW. The investigations cover emissions of particulates, relative and absolute particle distribution, unburned and CO and NOsub(x) emissions. Influence of crude mix origin and properties is studied. Influence of inorganic compounds on particulate weight is calculated. Fuel oils blended from visbreaker residues to viscositites in the range 380 cSt/50 degrees C - 650 cSt/50 degrees C are burned efficiently by water oil emulsion technique in plants originally designed for hydroskimming type fuel oils with max 2% asphaltenes. Water oil emulsion combustion: - Reduced particulates, CO and unburned. Particulates increased with decreasing O/sub 2/ content of the flue gas and increasing load. - Reduced the relative and absolute amount of particles with small diameter. - Reduced NOsub(x) formation. - Was not influenced by asphaltene and carbon number of oils with S <= 1%. Water oil emulsion combustion involves a second rapid atomization of oil drops creating a very large contact surface. Rotary cup burners give best cost effective performance with oil 380-650 cSt/50 degrees C. NOsub(x) formation is low. Oxygen content of flue gas is important for emissions and operating costs when water oil emulsion combustion is used. Water oil emulsion combustion reduced NOsub(x) by approx 10 NOsub(x)/MJ/5% water. Combination of water oil emulsion combustion with a decrease of 10% load resulted in 25% NOsub(x) reduction.

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 10839, 10840

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 10841, 10843, 12321

10880 (CONF-8511245—Pt.1, pp A4 1-23) **Reservoir management considerations in the Frigg field.** Barril, R. 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750636.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

The Frigg field in the North Sea was discovered in 1971. It consists of turbiditic deposits, in which gas and oil were encountered. The gas had a maximum height of 160 m and overlaid a thin oil disk of 10 m thickness, and a limited aquifier. Prior to the development decision it was demonstrated that the exploitation of the oil desk was not economic. The gas accumulation, estimated to 265 billion standard m3, was large enough for an economic development. On a more general point of view, the Frigg experience leads to some considerations in terms of reservoir management. A gas field is more stringent than an oil field due to the contractual obligations attached to the gas sales with respect to daily production and deliverability. Therefore it is even more compulsory to perform a con-

tinuous check-up of the field. Any deviation from the expected behavior, any new information has to be analyzed without delay in order to improve the reservoir model. Another consideration is that the appraisal program, before development and exploitation, is never as extensive as reservoir engineers would like it to be, due to obvious economic reasons, especially offshore. Nowadays, the high resolution 3-dimensional seismic survey has reacted a high degree of definition. It is thus a tool which has to be considered from the start, for the reservoir definition. The third consideration relates to the definition of the geological model, which is the basis of any reservoir construction. It is a general observation that the complexity of a geological model increases with time or depletion, according to a parabolic law. The Frigg field does not constitute an exception in this respect.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 10839, 10840, 10841, 10843, 10848, 10849, 10858, 10871, 10880

10881 **(CONF-840903—) Preprints of the 1984 International Gas Research Conference.** (Gas Research Inst., Chicago, IL (USA); American Gas Association, Inc., New York; USDOE, Washington, DC). 1 Jun 1984. 877p. Government Institutes, Inc., 966 Hungerford Dr., No. 24, Rockville, MD 20850. File Number TI87002224.

From International gas research conference; Washington, DC, USA (10 Sep 1984).

Papers in this volume are grouped under four major categories; (1) natural gas production; (2) coal gasification processes; (3) industrial utilization; and (4) residential/commercial utilization. Subcategories for natural gas production include: natural gas resource potential; tight formations; and coalbed methane. Substitute natural gas includes: coal gasification processes; coal gasifiction technology methane from biomass; and methane from wastes. Under category on industrial utilization are industrial combustion systems, industrial processes, and high temperature ceramic recuperation. Under the fourth category, residential/commercial utilization, the following topics are covered: residential and commercial space conditioning; appliances; and residential and commercial applications. Selected papers have been processed for inclusion in the Energy Data Base.

10882 **(BG-Trans—08070) A process for the removal of sulphur compounds from gas mixtures.** Baur, K.; Haeussinger, P.; Fruhstorfer, L.; Neubert, H.J. (British Gas Corp., London; Linde A.G., Wiesbaden (Germany, F.R.)). 1986. Translation of German Patent Application DE 3,421,507 A1, 6 Aug 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900425.

A process is described for the removal of sulphur compounds, especially H2S, from gas mixtures by scrubbing with a physical solvent which after the absorption of the sulphur compounds is regenerated and re-used. To improve the absorption and desorption of the sulphur compounds, and to make possible a separation of sulphur formed as a solid it is proposed to add to the solvent an oxidant to convert the sulphur compounds to elementary sulphur, as well as an additive accelerating the rate of reaction of the conversion and/or promoting the sedimentation of the sulphur formed.

0304 Products And By-products

REFER ALSO TO CITATION(S) 11013

0305 Health And Safety

REFER ALSO TO CITATION(S) 10887, 12530

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 10839, 10863, 10864, 11463, 11465, 11466

10883 **(CONF-8511245—Pt.4, pp A15 1-22) US LNG market. The need for marketing flexibility.** Thomas, R.C. 1985. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750639.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

Inevitably, domestic US reserves and deliverability will be inadequate to meet the nation's future gas requirements. The supply gap will have to be filled by other sources of supply, including liquefied natural gas (LNG). The size and location of the Haltenbanken and Troms gas reserves make LNG from Norway a prime candidate to fill this future need. Innovative marketing approaches to serve various US markets will further enhance Norwegian LNG's role in future US gas supply. The shipping distances to points in North America as well as Western Europe from liquefaction sites in Norway for the Haltenbanken and Troms natural gas, provide greater market flexibility than a pipeline to transport gas solely for European use. Pricing will be the key consideration to marketing LNG. The ability for LNG to compete with alternate fuels as well as other gas supplies will greatly depend on successful efforts to reduce the large capital reqirements of LNG facilities through new construction technology.

10884 **(DOE/EIA—0130(86/10)) Natural gas monthly, October 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Dec 1986. 179p. NTIS, PC A09/MF A01 - GPO; 1; GPO Dep. File Number DE87004095.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1980 through October 1986, with monthly data for the most recent 3 years. Some data are also given by state or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Explanatory notes, a discussion of data sources, and a glossary are included. Three reports previously published as separate annuals are now published in this report. The three are: "Underground Natural Gas Storage in the United States" (DOE/EIA-0239); "US Imports and Exports of Natural Gas" (DOE/EIA-0188); and "Main Line Sales of Natural Gas to Industrial Users" (DOE/EIA-0129). Featured article for this month is "Historical Drilling Activity, Drilling Costs, and Wellhead Prices in the Lower 48 States." 6 figs., 34 tabs.

10885 **(DOE/EIA—0131(85)) Natural gas annual 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 24 Nov 1986. 280p. NTIS, PC A13/MF A01 - GPO; 1; GPO Dep. File Number DE87003339.

This publication provides information on the reserves, production, imports, exports, interstate movements, storage, consumption, and price of natural gas to a wide audience including industry, consumers, government agencies, and educational institutions. The data in the 1985 Annual are presented in a sequence that follows natural gas (including supplemental supplies) from production to end use. Annual summary data on the quantity and average price of natural gas production at the State and national levels are presented, as well as total gas supply/disposition balances. Data on the quantity and price of natural gas consumption are shown for major

end-use categories by State. Historical data are then shown in the same sequence. 15 figs., 46 tabs.

10886 **(ESC-WR—86-20) Natural gas revenues in The Netherlands 1985-2000.** Koenders, N.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Oct 1986. 6p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The governmental natural gas revenues will go down considerably during the next years. After reaching a very low level in 1988 they are expected to increase slightly up to 1990. As a result of an increasing share of the Groningen gas, these revenues may still go up during the last decade of this century, if sales remain practically constant. Termination of export contract will then again cause a drop in revenues. 5 figs., 1 tab., 9 refs.

0307 Waste Management

REFER ALSO TO CITATION(S) 12280

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 12530

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 11466

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 10870, 10871, 10872

10887 **(PB—87-114112/XAB) Analytical techniques for selection of repair-or-replace options for cast-iron gas piping systems--Phase I. Topical report, March 1985-June 1986.** Kulkarni, R.B.; Golabi, K.; Chuang, J. (Woodward-Clyde Consultants, Walnut Creek, CA (USA)). 1986. 83p. NTIS, PC A05/MF A01.

A Cast Iron Maintenance Optimization System (CIMOS) was developed to identify failure-prone segments of cast-iron gas-piping systems and to determine the most-economical timing for replacing specific segments of such piping systems. The CIMOS provides a practical analytical tool that can be used by the gas industry to: (a) estimate probabilities of breaks and leaks on different cast-iron piping-system segments; (b) evaluate whether it is more economical (in terms of total current and future expected costs) to replace any given pipeline segment in the current year or to continue maintaining it with repairs as needed; (c) find the optimal group of pipeline segments to be replaced, and their priority order, for any designated budget; and (d) select the most cost-effective repair policy for those segments which would not be replaced. The CIMOS was fully developed and tested by one gas utility.

10888 **(BG-Trans—15024) Bending stress and deflection of the cross section of buried pipes.** Takagi, M.; Nishio, N. (Tokyo Gas Research and Development Inst. (Japan); British Gas Corp., London). 1986. Translated from 30th annual technical report of the Tokyo Gas Research and Development Institute, pp 23-39. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900468.

When designing cross sections of buried pipes, external forces such as earth pressure and pressures exerted by loaded vehicles are usually taken into consideration by applying the 'moment factors' prescribed by the Gas Utility Industry Law (GUIL) standard. For the design of buried pipes in general, the Iowa formula, proposed by Spangler, is widely used. However, the manner in which moment factors and the Iowa formula were derived is not well understood even by those using them. The present report, therefore, discusses them in detail, paying special attention to the processes by which they were established, and clarifies the physical concepts of design parameters (constants) used. In addition, it examines briefly basic concepts relating to changes in the cross section and to the 'flexibility' index. 7 refs., 15 figs., 8 tabs.

0330 Properties

REFER ALSO TO CITATION(S) 10770

10889 **(DOE/MC/22221—2210) An experimental study of hydrate formation rates: Final technical report.** Holder, G.D. (Pittsburgh Univ., PA (USA)). Aug 1986. Contract AC21-85MC22221. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001023.

An experimental study of the rates of hydrate formation is being conducted. An experimental design where the surface area per unit mass is known is being utilized. This experiment will be the first step in allowing estimates of the potential growth rate of hydrates in the earth. 25 refs., 15 figs., 1 tab.

0340 Combustion

REFER ALSO TO CITATION(S) 10881, 11584

04 OIL SHALES AND TAR SANDS

10890 **(DOE/METC—86/6057) Extractors manual for Oil Shale Data Base System: Major Plants Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Aug 1986. Contract AC21-85MC21353. 503p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE86006561.

To date, persons working in the development of oil shale technology have found limited amounts of reference data. If data from research and development could be made publicly available, however, several functions could be served. The duplication of work could be avoided, documented test material could serve as a basis to promote further developments, and research costs could possibly be reduced. To satisfy the engineering public's need for experimental data and to assist in the study of technical uncertainties in oil shale technology, the Department of Energy (DOE) has initiated the development of a data system to store the results of Government-sponsored research. A technology-specific data system consists of data that are stored for that technology in each of the specialized data bases that make up the Morgantown Energy Technology Center (METC) data system. The Oil Shale Data System consists of oil shale data stored in the Major Plants Data Base (MPDB), Test Data Data Base (TDDB), Resource Extraction Data Base (REDB), and Math Modeling Data Base (MMDB). To capture the results of Government-sponsored oil shale research programs, documents have been written to specify the data that contractors need to report and the procedures for reporting them. The documents identify and define the data from oil shale projects to be entered into the MPDB, TDDB, REDB, and MMDB, which will meet the needs of users of the Oil Shale Data System. This document addresses what information is needed and how it must be formatted for entry to the MPDB for oil shale. The data that are most relevant to potential Oil Shale Data System users have been divided into four categories: project tracking needs; economic/commercialization needs; critical performance needs; and modeling and research and development needs. 2 figs., 31 tabs.

10891 **(DOE/METC—86/6058) Extractors manual for Oil Shale Data Base System: Test Data Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Aug 1986. Contract AC21-85MC21353. 443p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE86006562.

The most abundant energy sources in the United States are hydrocarbon fossil fuels consisting of oil, gas, oil shale, and coal. Currently, the most important of these energy sources are crude oil and natural gas. Although supplies are adequate today, it must be realized that oil and gas are depletive substances. Within the next few years, the increasing demand for liquid fuels will necessitate the supplemental supplies of domestic energy from crude oil and natural gas with synthetic fuels such as those from oil shale. To

date, those persons working in the development of oil shale technology have found limited amounts of reference data. If data from research and development (R & D) could be made publicly available, however, several functions could be served. The duplication of work could be avoided, documented test material could serve as a basis to promote further developments, and research costs could possibly be reduced. To capture the results of Government-sponsored oil shale research programs, documents have been written to specify the data that contractors need to report and the procedures for reporting them. The documents identify and define the data from oil shale projects to be entered into the Major Plants Data Base (MPDB), Test Data Data Base (TDDB), Resource Extraction Data Base (REDB), and Math Modeling Data Base (MMDB) which will meet the needs of the users of the oil shale data system. This document addresses what information is needed and how it must be formatted so that it can be entered into the TDDB for oil shale.

10892 **(DOE/METC—86/6059) Extractors manual for Oil Shale Data Base System: Resource Extraction Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Aug 1986. Contract AC21-85MC21353. 201p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86006563.

Recognizing the need to gather and make available to the private sector the results of past and current research, the Department of Energy (DOE) is developing an Oil Shale Data System within the data system at the Morgantown Energy Technology Center (METC). The oil shale system is a computer-based data storage and retrieval system that serves as a repository for relevant oil shale information. The Oil Shale Data System is composed of several independent data bases. These include the Major Plants Data Base (MPDB), the Test Data Data Base (TDDB), the Resource Extraction Data Base (REDB), and the Math Modeling Data Base (MMDB). The structure of the Resource Extraction Data Base is shown. To determine the types of data to be collected and entered into the Oil Shale Data System, the needs of potential users have been identified.

10893 **(DOE/METC—86/6070) Extractors manual for Oil Shale Data Base System: Math Modeling Data Base.** (USDOE Morgantown Energy Technology Center, WV; EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Aug 1986. Contract AC21-85MC21353. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86006595.

The most abundant energy sources in the United States are the hydrocarbon fossil fuels consisting of oil, gas, oil shale, and coal. Currently, the most important energy sources are crude oil and natural gas. Although supplies are adequate today, it must be realized that oil and gas are depletive substances. Within the next few years, the increasing demand for liquid fuels will necessitate the supplemental supplies of domestic energy from crude oil and natural gas with synthetic fuels as those from oil shale. To date, those persons working in the development of oil shale technology have found limited amounts of reference data. If data from research and development (R and D) could be made publicly available, however, several functions could be served. The duplication of work could be avoided, documented test material could serve as a basis to promote further developments, and research costs could possibly be reduced. To assemble the available oil shale data for public use, the United States Department of Energy (DOE) is developing an oil shale data base. The Math Modeling Data Base (MMDB) for oil shale will be used to catalogue computer software and provide details for the applicability of each computer code that is available at the Morgantown Energy Technology Center (METC).

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 10769, 11467

10894 **(DOE/LC/11061—T11) Establishment and maintenance of an oil shale sample bank: Technical progress report, October-November 1986.** (Terra Tek, Inc., Salt Lake City, UT (USA)). 15 Dec 1986. Contract AC21-85LC11061. 35p. NTIS, PC A03. File Number DE87003351.

Western Shales - Discussions were held with Union Oil - Parachute, Colorado, concerning sampling of high grade Mahogany zone shale from their mine (35 gpt). Permission was granted by Union for acquisition of a Reference Shale. DOE declined the opportunity because of the proximity of this shale to the EXXON Colony Mine reference shale already acquired (approx. 27 gpt). A substantial effort was expended in discussions with the USBLM regarding sampling at the White River Oil Shale Mine, Vernal, Utah. Permission to sample is pending during preparation of a Land Use Plan by the BLM. We are now evaluating a road cut near Rock Springs, Wyoming as a potential source for the FY-1986 reference shale. The cut is near US I-80 west of Rock Springs. Channel samples have been obtained for Fischer Assay. Formal application to the land owners (USBLM or the Wyoming Grazing Association) for permission to sample will be made pending the outcome of the Fischer Assays. We investigated potential sources of spent shale for use by the University of Wyoming. A report summarizing these efforts is attached. Preliminary analytical results for the FY-86 reacquired Western Shale are attached. Eastern Shale - The FY-86 reference shale was reacquired in October. We resampled the Clegg Creek Member of the New Albany shale at the exposure in Knieriem's Quarry, Louisville, Kentucky. Ten sample splits were submitted for characterization. We agreed to provide up to 20 Fischer Assays of core recovered by HYCRUDE from a quarry in Michigan. Pending actual submittal of samples for analysis and adequate oil yields, we will submit the site for consideration as the source of the FY-87 Eastern Reference Shale.

0404 Oil Production, Recovery, And Refining

10895 **(DOE/FE/60177—2244) Three-dimensional laboratory simulation of the hot-gas injection process for tar sand.** Johnson, L.A. Jr.; Thomas, K.P.; Glaser, R.R. (Western Research Inst., Laramie, WY (USA)). Jul 1985. Contract FC21-83FE60177. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004291.

In situ recovery technologies for tar sand and heavy oil are simulated at the Western Research Institute to develop a technological base for understanding in situ processing of these resources. Wide ranges of process parameters are tested in a one-dimensional tubular reactor in which the tar sand or heavy oil sand is uniformly reconstituted to nearly the same permeability and porosity as the field resource. Three-dimensional process performance is evaluated by testing the most promising operating parameters in consolidated blocks of the field resource. The potential of hot-gas injection for the preheat and production of tar sand has been evaluated with three-dimensional and one-dimensional laboratory simulations. The three-dimensional simulation has shown that by using a fracture, a highly saturated tar sand can be heated while a significant portion of the bitumen is produced. Oil production rate, residual saturation, and produced oil quality have been measured for various operating parameters. The characteristic shape of the temperature responses in the three-dimensional block indicates that both conduction and convection are significant heat transfer mechanisms. The two most influential operating parameters have been found to be the heat input rate and the injected gas temperature. 2 refs., 11 figs., 5 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 10894, 10895, 11819, 11996

10896 Isolation and FIMS analysis of saturated hydrocarbons from tar sand bitumens. Holmes, S.A.; Raska, K.A. (Western Research Institute, Laramie, WY (USA)). *Fuel;* **65**: No. 11, 1539-1545(Nov 1986).

Saturated hydrocarbons in two Utah tar sand bitumens were determined via compound-type isolation and mass spectral analyses. Four analytical methods for isolating saturated hydrocarbons were evaluated: 1) dewaxing, 2) modified deasphaltening, 3) adsorption and complexation chromatography, 4) desorptive Soxhlet extraction followed by complexation chromatography. The latter method was preferred for concentrating the greatest amount of saturated hydrocarbons without overlap from aromatic or heteroatom-containing species. Field ionization mass spectrometry (FIMS) adequately profiled these hydrocarbons by molar mass (m/z) and by Z-series type. The sample of Northwest Asphalt Ridge bitumen was comprised of a wax of mostly acyclic and monocycloalkanes; whereas, the saturates from the sample of Asphalt Ridge bitumen were mostly tetracyclo- and pentacycloalkanes. Based upon a comparison of the saturate distributions in the samples of bitumen, the sample from the Northwest Asphalt Ridge deposit was found to have undergone less biodegradation. This wax-like sample of bitumen may have migrated to the deposit at a later time than the major bitumen generation and/or resulted from physicochemical segregation of waxy organic matter in the reservoir. 22 refs., 5 figs., 2 tabs.

0409 Waste Research And Management

10897 (DOE/METC—86/6071) Research needs for the surface disposal of processed oil shale solid waste: Physical, hydrological, and geochemical parameters. Reeves, T.L.; Sullivan, P.J.; Gilbert, P.A.; Essington, M.E.; McQuisten, R.; Skinner, Q.D.; Hale, G.P. (USDOE Laramie Projects Office, WY). Aug 1986. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86006573.

The purpose of this study was to identify long-term, high-risk engineering-scale research needs and objectives associated with the solid waste management of processed oil shale. Specifically, this study identified important parameters that may affect the safe disposal of processed oil shale, assessed current state-of-the-art measurement techniques, and outlined suggested research needed to mitigate identified parameters. The research needs discussed emphasize data requirements for a commercial (engineering) scale facility and are outlined in six primary sections: (1) Site Characterization, (2) Basic Properties of Recently Processed Oil Shale, (3) Disposal and Weathering Factors Associated with Processed Shale Stability, (4) Erosion and Surface Stabilization of Processed Oil Shale, (5) Evaluation and Development of Analytical Models, and (6) Performance Monitoring of Prototype Processed Oil Shale Facilities. Identified research needs of major importance are those providing Baseline data, data characterizing the physical, chemical, and hydrologic properties of processed shale, and Physical Modeling Data, data from field studies, scaled physical modeling, and embankment prototypes. 39 refs., 1 fig., 1 tab.

0410 Environmental Aspects

10898 (DOE/ER/60121—1-Final) Environmental chemistry of energy residuals. Final report, January 1, 1983-June 30, 1986. Sievers, R.E.; Klein, D.A.; Meglen, R.R.; Ramirez, W.F.; Runnells, D.D. (Colorado Univ., Boulder (USA); Colorado State Univ., Fort Collins (USA). Dept. of Microbiology; Colorado Univ., Denver (USA). Center for Environmental Sciences). Sep 1986. Contract AC02-83ER60121. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001763.

This report presents the results from a multidisciplinary study of the environmental chemistry of energy derived materials, primarily from the processing of oil shale. Simulations of contaminant migration from planned oil shale waste disposal sites show that the partitioning of important contaminants can be described by linear distribution functions and imply that empirical adsorption parameters may be valid descriptors of adsorption in complex rock-fluid systems under defined conditions. Porous media properties of retorted oil shale have been measured and used to construct a model of leachate generation and transport. The model accounts for dead space volume in retorted shale and successfully predicts the breakout of tracer substances. Microbiological studies indicate that only with added nutrients will microbial communities contribute to detectable mobilization of arsenic found in natural porous energy residuals. The apparent environmental conditionality of arsenic mobilization by microbiological processes suggests that microbial contributions to trace metal dynamics can be managed to meet specific environmental objectives. Pattern recognition techniques have been applied to the evaluation of contamination from oil shale retorting. The results illustrate that these techniques improve and simplify the presentation of multidimensional data, determine how many parameters are needed to distinguish whether retort operation has affected water quality. In contrast to wastewaters stored in closed systems, exposure of untreated shale oil wastewaters to sufficient amounts of air results in the emission of large quantities of aromatic nitrogen-containing compounds, ketones, nitriles, and phenols.

10899 Trace element and salt movement in retorted oil shale disposal sites. Stark, J.M.; Redente, E.F. (Colorado State Univ., Fort Collins). *Journal of Environmental Quality;* **15**: No. 3, 282-288(Jul-Sep 1986). Contract AC02-76EV04018.

The direction and amount of salt and trace element movement within retorted shale disposal piles is a major environmental concern. This study examines the redistribution of soluble salts and trace elements (As, B, Cd, Cu, F, Fe, Mn, Mo, Na, Ni, Pb, Se, and Zn) in retorted shale test plots with different topsoil treatments 6 yr after construction. Topsoil treatments included no topsoil, no topsoil and leached with 76-cm water, 30-cm topsoil, 60-cm topsoil, 90-cm topsoil, 60-cm topsoil and capillary barrier, and a disturbed soil control (no retorted shale). Soluble salts especially Na salts) and F showed considerable movement both upwards and downwards in the profiles. Molybdenum showed some movement in both directions. The remaining elements showed little or no movement out of the shale layer. Increasing topsoil depths resulted in less salt or trace element movement in either direction. Use of a capillary barrier between the topsoil and retorted shale prevented upward migration of salts and trace elements. After 6 yr the exposed shale treatments (both leached and unleached) continued to have considerably higher salt and trace element contents than any other treatment. Because of limited rooting depths, deeper percolation of moisture is occurring on plots containing retorted shale than on the control plot.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 11446

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 11755, 12287

10900 (INIS-BR—549) Metamorphism, metasomatism and mineralization at Lagoa Real, Bahia, Brazil. Lobato, L.M. (University of Western Ontario, London (Canada). Dept. of Geology). Sep 1985. 322p. NTIS (US Sales Only), PC A14/MF A01. File Number DE87700427.

Uranium deposits cumulatively in the 100,000 tonne U_3O_8 range occur within ductile shear zones transecting Archean basement gneisses of the Sao Francisco Craton, at the Lagoa Real region of south-central Bahia, Brasil. The gneisses, dated at 2.6-3.0Ga, are at amphibolite and granulite facies and overlie to the west, the Proterozoic Espinhaco metasedimentary sequence along a thrust fault. Petrography and mineral chemistry show that in the zones of alteration/mineralization, the original K-feldspar + quartz + albite/oligoclase + hastingsite assemblage, is replaced by albite + aegirine - angite + andradite + hematite assemblages, with or without uraninite. This information along with oxygen isotope, whole rock geochemistry and fluid inclusion studies indicate that

the alteration process involves removal of Si, K, Rb, Ba and addition of Na under oxidizing conditions. V, Pb and Sr were introduced along with U via interaction with saline SO_2 - rich, isotopically light fluids under varying water/rock ratios and at temperatures of 500-550°C. $^{87}Sr/^{86}Sr$ systematics suggest that it is unlikely that Sr, and by extension uranium, were introduced by fluids originating from the basement gneisses. Geological constraints and the general alteration pattern are consistent with the release of the mineralizing fluids in response to the overloading of the basement rocks onto the Sedimentary Espinhaco via a thrust mechanism.

10901 **(INIS-BR—550) Ore reserve estimation: a summary of principles and methods.** Marques, J.P.M. (NUCLEBRAS, Rio de Janeiro (Brazil)). 1985. 67p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700428.

The mining industry has experienced substantial improvements with the increasing utilization of computerized and electronic devices throughout the last few years. In the ore reserve estimation field the main methods have undergone recent advances in order to improve their overall efficiency. This paper presents the three main groups of ore reserve estimation methods presently used worldwide: Conventional, Statistical and Geostatistical, and elaborates a detaited description and comparative analysis of each. The Conventional Methods are the oldest, less complex and most employed ones. The Geostatistical Methods are the most recent precise and more complex ones. The Statistical Methods are intermediate to the others in complexity, diffusion and chronological order. (D.J.M.).

10902 **(INIS-BR—551) Hydrogeologic characterization of the Cachoeira Deposit Massif, Caetite, state of Bahia, Brazil.** Bottura, J.A.; Albuquerque Filho, J.L.; Ojima, L.M. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1984. 17p. (In Portuguese). (CONF-8404319—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700429.

From 4. Brazilian Congress of Engineering Geology; Belo Horizonte, Brazil (23 Apr 1984).

The hydrogeologic applications for the characterization of rock massifs in future mining activity areas are presented. The study was performed in the Cachoeira uranium deposit (Anomaly No. 13 - Lagoa Real Project) located in the south-central portion of the state of Bahia, Caetite municipality, belonging to the Brazilian Nuclear Enterprise - NUCLEBRAS. The massif occurring in the area is composed of a group or series of rocks classified generically as gneisses, displaying different geotechnical classes. In order to consubstantiate the hydrogeologic/ hydrogeotechnical characterization, pumping and infiltration tests were performed, as well as periodic water level measurements in piezometers and drill-holes. In this manner, a hydrogeotechnical classification was made possible and a quantitative evaluation of the volume of water that will be drained was elaborated, providing necessary contributions for research diggings and exploration. (D.J.M.).

10903 **(INIS-BR—552) Superficial drainage studies in open-pit mines.** Teixeira Junior, P.B.; Leite, C.B.B. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1984. 15p. (In Portuguese). (CONF-8404319—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700430.

From 4. Brazilian Congress of Engineering Geology; Belo Horizonte, Brazil (23 Apr 1984).

Drainage studies concerning large open-pit mining projects can be of vital importance throughout the mining activity itself as they may assist in avoiding activity interruptions due to drainage problems, therefore representing substantial savings. These studies should, in fact, be carried out from the initial activity stages and shall be considered in operational, project and planning decisions in order to optimize results and reduce costs. This specific study presents a drainage study systematization proposal, enphasazing economic decision criteria. The authors comment on studies of this nature developed at the Caldas uranium mine - NUCLEBRAS. (D.J.M.).

10904 **(INIS-BR—553) Seismic refraction technique applications in the geotechnical characterization of the Cachoeira deposit massif, Caetite, State of Bahia, Brazil.** Malagutti Filho, W.; Oliveira Braga, T. de. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1984. 10p. (In Portuguese). (CONF-8404319—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700431.

From 4. Brazilian Congress of Engineering Geology; Belo Horizonte, Brazil (23 Apr 1984).

Geophysical surveys throughout the Cachoeira Uranium deposit massif were carried out with the purpose of assisting in the geotechnical characterization for the implementation of the Mining-Industrial Complex projects on the Lagoa Real uranium deposits, Caetite municipality, state of Bahia, Brazil. This study discusses the methodology utilized in the geophysical surveys and their results as well as their applications to the geotechnical characterization as a whole. (D.J.M.).

10905 **(INIS-BR—554) Geologic and geotechnical contributions to the Lagoa da Rabicha and Cachoeira mines projects, Lagoa Real, State of Bahia, Brazil.** Tognon, A.A.; Costanzo Junior, J.; Ojima, L.M.; Oliveira Braga, T. de; Mueller, M. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil); NUCLEBRAS, Belo Horizonte (Brazil)). 1984. 11p. (In Portuguese). (CONF-8404319—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700432.

From 4. Brazilian Congress of Engineering Geology; Belo Horizonte, Brazil (23 Apr 1984).

The procedures and systematics involved in obtaining basic geologic-geotechnical, geomechanical and hydrogeotechnical parameters to serve as an aid in the planning of mining activities for the Lagoa da Rabicha and Cachoeira deposits, located in the Lagoa Real uranium District, are presented and discussed. These deposits occur in the Caetite massif, composed mainly of Gneissic lithologies. The studies were performed in order to provide the essential elements for an initial geologic-geotechnical characterization of the massifs. (D.J.M.).

10906 **(INIS-BR—555) Geologic and geotechnical contributions to the Itataia mine project, State of Ceara, Brazil .** Tognon, A.A.; Virgili, J.C.; Mueller, M. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil); NUCLEBRAS, Belo Horizonte (Brazil)). 1984. 9p. (In Portuguese). (CONF-8404319—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700433.

From 4. Brazilian Congress of Engineering Geology; Belo Horizonte, Brazil (23 Apr 1984).

The procedures and systematics involved in obtaining basic geologic-geotechnical geomechanical and hydrogeo-technical parameters to serve as an aid in the planning of mining activities for the Itataia deposit located in the Itatira uranium district are presented and discussed. The studies were performed in order to provide the essential elements for an initial geologic-geotechnical characterization of the massif. (D.J.M.).

10907 **(INIS-BR—560) Mining planning introduction.** Toledo, R.D. (International Atomic Energy Agency, Vienna (Austria)). 1985. 121p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87700434.

Basic concepts concerning mining parameters, plan establishment and typical procedure methods applied throughout the physical execution of mining operations are here determined, analyzed and discussed. Technological and economic aspects of the exploration phase are presented as well as general mathematical and statistical methods for estimating, analyzing and representing mineral deposits which are virtually essential for good mining project execution. The characterization of important mineral substances and the basic parameters of mining works are emphasized in conjunction with long, medium and short term mining planning. Finally, geological modelling, ore reserves calculations and final economic evaluations are considered using a hypothetical example in order to consolidate the main elaborated ideas. (D.J.M.).

10908 **(PER—95) Interpretation of the aeromagnetic data covering portion of the Damara orogenic belt, with special reference to the occurrence of uraniferous granite.** Corner, B. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria; University of the Witwatersrand, Johannesburg (South Africa)). Dec 1982. 128p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87700265.

A thesis submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the Degree of Doctor of Philosophy. Contains a folder with maps.

This thesis comprises primarily palaeomagnetic studies within the Damara orogenic belt of South West Africa (Namibia), as well as an interpretation of the regional structure, utilizing published aeromagnetic data. The prime objectives of the study were to aid uranium exploration programmes in this area by establishing any possible magnetic relationships associated with the uraniferous granites in the area, and to interpret regional structure from the aeromagnetic data. Cursory interpretation of the airborne radiometric data is also undertaken. Gravity traverses, conducted across three dome structures with which uranium mineralisation is intimately associated, are interpreted in order to determine the origin of these structures.

0504 Feed Processing

REFER ALSO TO CITATION(S) 10938, 11784

0505 Uranium Enrichment

10909 **U-235 enrichment determination via gamma spectroscopy-improved calibration and "unknown" sample assay.** Proctor, A.E. (Idaho National Engineering Lab., EG & G Idaho, Inc., Idaho Falls, ID). *Nuclear Materials Management;* **14**: No. 2, 37-43(1986).

An improved method of calibrating NDA gamma spectroscopic instrumentation for U-235 enrichment determination is presented. The calibration utilizes a chi-squared minimization method to fit two coefficients to the data. Sources of uncertainty in the initial data are used to "weight" the fit; uncertainties are computed for the two fitting coefficients. The calibration procedure and calculation of "unknown" enrichments is demonstrated. Only simple counting instrumentation is needed; calculations can be readily handled by small computers. An example calculation and program listings are included.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 10911

10910 **Differential thermal analysis of U/sub 3/Si-Al and U/sub 3/Si/sub 2/-Al reactions.** Domagala, R.F.; Wiencek, T.C.; Snelgrove, J.L.; Homa, M.I.; Heinrich, R.R. (Argonne National Lab., Materials Science & Technology Lab., Argonne, IL 60439). *American Ceramic Society Bulletin;* **65**: No. 8, 1164-1170(Aug 1985). Contract W-31-109-ENG-38.

As part of the Reduced Enrichment Research and Test Reactor program, high density uranium compounds are being evaluated as possible replacements for the fuels currently in use. U/sub 3/Si and U/sub 3/Si/sub 2/ powders dispersed in an Al matrix and roll-bonded within 6061 Al alloy clad have performed well under irradiation. Neither silicide shows any measurable heat of reaction until the solidus temperature of 6061 (582°C) is exceeded. The exothermic reaction is quenched by the endothermic change of state as the Al species melt. All detectable events take place in the temperature regime from ≈580° to ≈660°C. The heats of reaction per gram of fuel ranged from 304+.18 J for samples with 32 vol% U/sub 3/Si/sub 2/ in the fuel zone to 486+.54 J for samples containing 45 vol% U/sub 3/Si in the fuel zone.

0508 Spent Fuels Reprocessing

10911 **(INIS-BR—544) Cation interdiffusion in the UO_2-(U, Pu)O_2 and UO_2 - PuO_2 systems.** Leme, D.G. (Sao Paulo Univ. (Brazil)). 1985. 181p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. File Number DE87700415.

The interdiffusion of U and Pu ions in UO sub(2 +- x) - (U sub(0.83) Pu sub(0.17))O sub(2 + - x) and UO sub(2 + - x) -PuO sub(2 - x) sintered pellets and UO sub(2 +- x) -(U sub(0.82) Pu sub(0.18))O sub(2 + - x) single crystals has been studied as a function of the oxygen potential ΔG sup(-) (O_2) or the stoichiometric ratio O/M. The diffusion profiles of UO_2/(U,Pu)O_2 and UO_2/PuO_2 couples of different O/M ratios have been measured using high resolution α-spectrometer and microprobe. Thermal annealing of the specimens was performed in controlled atmospheres using either CO-CO_2 gas mixtures for constant O/M ratios or purified argon. The interdiffusion profiles have been analysed by means of the Boltzmann-Matano and Hall methods. The interdiffusion coefficient D sus(approx.) increases with increasing Pu content in sintered pellets (up to 17 wt. %PuO_2) showing a strong dependence of D sup(approx.) on the O/M ratio. The micropobe results show that the interdiffusion along grain boundaries is the main diffusion mechanism in the pellets. Experiments have also been carried out in single crystals to measure just the bulk-interdiffusion and avoiding effects due to grain boundaries. A marked dependence of D sup(approx.) on O/M ratio or on oxygen potential ΔG sup(-) (O_2), similar to the dependence already reported for self diffusion by means of radioactive tracers, has also been observed.

0509 Transport And Storage

10912 **(EGG-M—35186) Spent fuel transportation: A success story.** Gertz, C.P.; Schoonen, D.H.; Wakeman, B.H. (USDOE Idaho Operations Office, Idaho Falls; EG and G Idaho, Inc., Idaho Falls (USA); Virginia Power Co., Richmond (USA)). 29 Oct 1986. Contract AC07-76ID01570. 8p. (CONF-861102—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002609.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Spent fuel research and development demonstrations and associated transportation activities are being performed for DOE's Office of Civilian Radioactive Waste Management (OCRWM) as a part of the storage cask performance testing programs at the Idaho National Engineering Laboratory (INEL). These spent fuel programs support the Nuclear Waste Policy Act (NWPA) and Department of Energy objectives for cooperative demonstrations with the utilities, testing at federal sites, and alternatives for viable transportation systems. The shipment of spent fuel to the INEL from the Surry Power Station and the Nevada Test Site required shipping plans and coordination between DOE, EG and G Idaho, and Virginia Power transportation personnel, as well as extensive communication with the corridor states. 8 figs., 3 tabs.

10913 **(EPRI-NP—4830) The effects of target hardness on the structural design of concrete storage pads for spent-fuel casks: Final report.** Rashid, Y.R. (Anatech International Corp., La Jolla, CA (USA)). Oct 1986. 85p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920130.

The loading experienced by spent fuel dry storage casks and storage pads due to potential drop or tip-over accidents is evaluated using state-of-the-art concrete structural analysis methodology. The purpose of this analysis is to provide simple design charts and formulas so that design adequacy of storage pads and dry storage casks can be demonstrated. The analysis covers a wide range of slab-design parameters, e.g., reinforcement ratio, slab thickness, concrete compressive strength, and sub-base soil compaction, as well as variations in drop orientation and drop height. The results are presented in the form of curves, giving the force on the cask as a function of storage pad hardness for various drop heights. In addition, force-displacement curves, deformed shapes, crack patterns, stresses and strains are given for various slab-design conditions and

drop events. The utility of the results in design are illustrated through examples.

10914 **(PNL—5974) Castor-1C spent fuel storage cask decay heat, heat transfer, and shielding analyses.** Rector, D.R.; McCann, R.A.; Jenquin, U.P.; Heeb, C.M.; Creer, J.M.; Wheeler, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 160p. NTIS, PC A08/MF A01. File Number DE87004029.

This report documents the decay heat, heat transfer, and shielding analyses of the Gesellschaft fuer Nuklear Services (GNS) CASTOR-1C cask used in a spent fuel storage demonstration performed at Preussen Elektra's Wurgassen nuclear power plant. The demonstration was performed between March 1982 and January 1984, and resulted in cask and fuel temperature data and cask exterior surface gamma-ray and neutron radiation dose rate measurements. The purpose of the analyses reported here was to evaluate decay heat, heat transfer, and shielding computer codes. The analyses consisted of (1) performing pre-look predictions (predictions performed before the analysts were provided the test data), (2) comparing ORIGEN2 (decay heat), COBRA-SFS and HYDRA (heat transfer), and QAD and DOT (shielding) results to data, and (3) performing post-test analyses if appropriate. Even though two heat transfer codes were used to predict CASTOR-1C cask test data, no attempt was made to compare the two codes. The codes are being evaluated with other test data (single-assembly data and other cask data), and to compare the codes based on one set of data may be premature and lead to erroneous conclusions.

10915 **(PNL—6049-Vol.1) COBRA-SFS [Spent Fuel Storage]: A thermal-hydraulic analysis computer code: Volume 1, Mathematical models and solution method.** Rector, D.R.; Wheeler, C.L.; Lombardo, N.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003966.

COBRA-SFS (Spent Fuel Storage) is a general thermal-hydraulic analysis computer code used to predict temperatures and velocities in a wide variety of systems. The code was refined and specialized for spent fuel storage system analyses for the US Department of Energy's Commercial Spent Fuel Management Program. The finite-volume equations governing mass, momentum, and energy conservation are written for an incompressible, single-phase fluid. The flow equations model a wide range of conditions including natural circulation. The energy equations include the effects of solid and fluid conduction, natural convection, and thermal radiation. The COBRA-SFS code is structured to perform both steady-state and transient calculations: however, the transient capability has not yet been validated. This volume describes the finite-volume equations and the method used to solve these equations. It is directed toward the user who is interested in gaining a more complete understanding of these methods.

10916 **(PNL—6074) Comparison of HYDRA predictions to temperature data from two single-assembly spent fuel heat transfer tests.** McCann, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87004221.

The HYDRA computer code was used to simulate the thermal performance of an actual and a model spent fuel assembly. The HYDRA-predicted temperatures were then compared with measured data from two single-assembly test sections. The objective of this effort was to further verify the predictive capabilities of the HYDRA code for use in assessments of the hydrothermal performance of spent fuel dry storage systems. After HYDRA has been adequately evaluated and validated, the code will be documented to permit design and licensing safety analyses.

10917 **(SAND—85-2827) Determination of effective thermal conductivities for a full-scale mock-up of a 217-element breeder reactor fuel assembly subjected to normal shipping conditions.** Sanchez, L.C.; Hudson, M.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 110p. (TTC—0635). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003780.

This report describes a modeling technique to determine effective conductivities and comparison with experimental data that were obtained on a full-scale mock-up of a breeder reactor fuel assembly subjected to conditions that occur during normal shipping. The analysis involved the determination of nonlinear effective conductivities that can be used in pure thermal conduction heat transfer codes to simulate the coupled phenomena of conduction, convection and thermal radiative heat transfer in the gas regions between individual elements. The results obtained in this study indicate that the temperature of the fuel pins in a Liquid Metal Fast Breeder Reactor (LMFBR) assembly, under normal conditions of transport within a shipping cask, can be estimated to within +- 35°F over the temperature range ($400 \leqq T \leqq 650$°F) with the use of an effective conductivity within a pure conduction heat transfer code. Results also indicated convection is a dominate heat transfer agent over the experimental temperature range, this finding was not shown in previous reports that analyzed experimental data from heat transfer within simulated breeder reactor fuel pin assemblies since: (1) the previous experiments were conducted at higher temperatures, at which radiation heat transfer dominates; (2) experiments were conducted only at atmospheric pressure; and/or (3) detailed analysis was not performed.

10918 **(ORNL/tr—86/77) Facility for the storage of spent, heat-emitting and container-enclosed nuclear reactor fuel assemblies.** Hennings, U. (Oak Ridge National Lab., TN (USA); Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.)). 15 Jan 1987. Contract AC05-84OR21400. Translation of German Patent Application DE 30 49 141 A 1, July 8, 1982. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003981.

Patent for facility for the storage of spent, heat-emitting and container-enclosed nuclear reactor fuel assemblies, which are arranged within a building in a horizontal position and are cooled by a gas stream, whereby the building has a storage and a loading zone, characterized by the fact that pallet trucks arranged one above the other in a row and such that an interspace is left for the receiving positions for the containers, the the pallet trucks can be moved along rails that extend between two side walls arranged opposite to one another in the storage zone, that the storage zone can be loaded and unloaded by opening located in these two side walls, and that the gas stream only circulates within the building.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 10903

10919 **Gamma-ray line intensities for depleted uranium.** Moss, C.E. (Los Alamos National Lab., Los Alamos, NM). pp 755-758 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Measurements of the gamma-ray line intensities from depleted uranium allowed the authors to determine which of two conflicting previous experiments was correct. For the 1001-keV line the authors obtained a branching ratio of 0.834 +. 0.007, in good agreement with one of the previous experiments. A table compares the intensities for several lines with those obtained in previous experiments.

0520 Waste Management

REFER ALSO TO CITATION(S) 10964, 10965, 10966, 10967, 10968, 10969, 10970, 10971, 10972, 10973, 10974, 10975, 10976, 10977, 10978, 10979, 10983, 10988, 11721, 11787, 11915, 12307, 12556, 12558, 12559

10920 (AD-A—172874/0/XAB) Posttest analysis of a laboratory-cast monolith of salt-saturated concrete. Final report. Wakeley, L.D.; Poole, T.S. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Sep 1986. 41p. (WES/MP/SL—86-13). NTIS, PC A03/MF A01.

A salt-saturated concrete was formulated for laboratory testing of cementitious mixtures with potential for use in disposal of radioactive wastes in a geologic repository in halite rock. Cores were taken from a laboratory-cast concrete monolith on completion of tests of permeability, strain, and stress. The cores were analyzed for physical and chemical evidence of brine migration through the concrete, and other features with potential impact on installation of crete plugs at the Waste Isolation Pilot Plant (WIPP) in New Mexico. The posttest analyses of the cores provided evidence of brine movement along the interface between concrete and pipe, and little indication of permeability through the monolith itself. There may also have been diffusion of chloride into the monolith without actual brine flow.

10921 (AECL—8402) Advanced containment research for the Canadian Nuclear Fuel Waste Management Program. Onofrei, M.; Mathew, P.M.; McKay, P.; Hosaluk, L.J.; Oscarson, D.W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1986. 34p. Scientific Document Distribution Offices, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. File Number TI87900396.

Work performed under Canada/US Waste Management Information Exchange Agreement.

This document outlines the program on the development of advanced containment systems for the disposal of used fuel in a vault deep in plutonic rock. Possible advanced containment concepts, the strategy adopted in selecting potential container materials, and experimental programs currently underway or planned are presented. Most effort is currently directed toward developing long-term containment systems based on non-metallic materials and massive metal containers. The use of additional independent barriers to extend the lifetime of simple containment systems is also being evaluated.

10922 (AIF/NESP—037) A guide for obtaining regulatory approval to dispose of very low level wastes by alternative means. Chan, D.W.; Davis, J.P.; Wofford, B.R. (General Physics Corp., Columbia, MD (USA)). Aug 1986. 75p. Atomic Industrial Forum, Inc., 7101 Wisconsin Ave., Bethesda, MD 20814-4891. File Number TI87900319.

Most low-level radioactive waste currently generated by NRC licensees is disposed of at facilities licensed by the Nuclear Regulatory Commission pursuant to NRC regulations. Only a limited number of such facilities exist now, and it will be many years before each region of the US has its own LLW disposal site. Because of limitations on the volume of wastes that will be accepted by the existing facilities, the rising costs of disposal, and the possibility that access to disposal facilities could be cut off completely, licensees have been adopting various waste management techniques. One strategy to reduce the volume of wastes that must be transferred to a licensed disposal facility is to obtain permission from NRC to dispose of very low-level wastes (VLW) by alternative means. The purpose of this study is to establish a step-by-step procedure for preparing 10 CFR 20.302(a) applications. Criteria for application approval are also suggested. The guidelines developed may be appropriate for adoption as NRC regulatory guidance. The initial step in carrying out this project was to interview NRC personnel regarding 20.302(a) applications and to review actual applications for approval of alternative disposal methods filed in recent years. Licensee representatives were also contacted. The data obtained from these sources were combined in this report. Information on alternative paths to regulatory approval was summarized. The documents relating to NRC review of 20.302(a) applications were analyzed and prevalent characteristics were identified. The actual step-by-step guidelines were based on the information summarized above.

10923 (BMI/ONWI—614) Regional ground-water flow modeling for the Paradox Basin, Utah: Second status report. (Intera Technologies, Inc., Austin, TX (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Sep 1986. Contract AC02-83CH10140. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87004150.

Regional ground-water flow within the principal geohydrologic units of the Paradox Basin is evaluated by developing a conceptual model of the flow regime between the shallow aquifers, the Paradox salt and the deep-basin brine aquifers. This model is tested using a three-dimensional, finite-difference flow code. Sensitivity analyses (a limited parametric study) are conducted to define the system responses to changes in the conceptual model. The conceptual model is described in terms of its areal and vertical discretization, aquifer properties, fluid properties, and hydrologic boundary conditions. The simulated results are described with potentiometric surfaces, tables summarizing the areal and vertical volumetric flows through the principal units, and Darcy velocities at specified points. The reported work is the second stage of an ongoing evaluation of the Gisbon Dome area within the Paradox Basin as a potential repository for high-level radioactive wastes. The results and conclusions should thus be considered preliminary and subject to modification with the collection of additional data. However, the report does provide a useful basis for describing the sensitivity of the present conceptualization of ground-water flow to the hydrologic parameters and, to a lesser extent, the uncertainties of the present conceptualization. 20 refs., 17 figs., 9 tabs.

10924 (BMI/ONWI—624) Brine migration test report: Asse Salt Mine, Federal Republic of Germany: Technical report. Coyle, A.J.; Eckert, J.; Kalia, H. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jan 1987. Contract AC02-83CH10140. 168p. NTIS, PC A08/MF A01. File Number DE87004144.

This report presents a summary of Brine Migration Tests which were undertaken at the Asse mine of the Federal Republic of Germany (FRG) under a bilateral US/FRG agreement. This experiment simulates a nuclear waste repository at the 800-m (2624-ft) level of the Asse salt mine in the Federal Republic of Germany. This report describes the Asse salt mine, the test equipment, and the pretest properties of the salt in the mine and in the vicinity of the test area. Also included are selected test data (for the first 28 months of operation) on the following: brine migration rates, thermomechaical behavior of the salt (including room closure, stress reading, and thermal profiles), borehole gas pressures, and borehole gas analyses. In addition to field data, laboratory analyses of pretest salt properties are included in this report. The operational phase of these experiments was completed on October 4, 1985, with the commencement of cooldown and the start of posttest activities. 7 refs., 68 figs., 48 tabs.

10925 (BNL—38913) Development and evaluation of polyethylene as solidification agent for low-level waste. Franz, E.M.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 11p. (CONF-860905—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003199.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

A polyethylene solidification process, using an extrusion system, has been developed for the immobilization of dry wastes resulting from volume reduction technologies. Ease of processibility and high packing efficiencies were obtained through the use of low-density polyethylene (0.917 to 0.924 g/cm^3) with melt indices from 2.0 to 55.0 g/10 min. Maximum waste loadings of 70 wt % sodium sulfate, 50 wt % boric acid, 40 wt % incinerator ash and 65 wt % ion exchnge were obtained. A series of tsts were conducted to assess the acceptability of polyethylene waste forms to meet the requirements of 10 CFR 61. Based on test results and process control considerations, optimal waste loadings of 70 wt % sodium sulfate,

50 wt % boric acid, 40 wt % incinerator ash and 30 wt % ion exchange resins are recommended.

10926 **(CONF-870238—1) Inventory of karst subsidence in the Valley and Ridge Province of East Tennessee.** Ketelle, R.H.; Newton, J.G. (Oak Ridge National Lab., TN (USA); LaMoreaux and Associates, Tuscaloosa, AL (USA)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002812.

From 2. multidisciplinary conference on sinkholes and the environmental impacts of karst; Orlando, FL, USA (9 Feb 1987).

The first regional inventory of karst activity in the Valley and Ridge Province of East Tennessee was performed as a part of ongoing studies at Oak Ridge National Laboratory pertaining to environmental impact assessment of waste disposal in karst settings. More than half the land area in the Valley and Ridge Province of East Tennessee is underlain by karst-prone carbonate bedrock. The regional karst inventory was initiated to obtain current information on the extent of active karst subsidence in the region for use in decision making by the Department of Energy in planning future waste disposal facilities at Oak Ridge, Tennessee. The inventory was performed by contacting personnel of federal, state, and county agencies to obtain reports of known active karst subsidence within the region. Data from these interviews were tabulated resulting in identificaton of more than 250 karst subsidence incidents in East Tennessee, most of which have occurred since 1980. Although the infomation obtained was largely anecdotal, approximate location, date, size, and circumstances under which the collapses occurred were recorded for as many cases as could be documented. The study also included detailed reconnaissance of selected areas similar in geology and hydrology to a study area at Oak Ridge, Tennessee to identify causative factors which contribute to karst subsidence in the region and for comparison of the occurrence of visible karst features at different sites. Human activities affecting site hydrology such as large scale land clearing and earthmoving projects were related to most of the subsidence incidents inventoried.

10927 **(CONF-8610189—1) Application of borehole geophysics to fracture identification and characterization in low porosity limestones and dolostones.** Haase, C.S.; King, H.L. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001683.

From Conference on surface and borehole geophysical methods and groundwater instrumentation; Denver, CO, USA (15 Oct 1986).

Geophysical logging was conducted in exploratory core holes drilled for geohydrological investigations at three sites used for waste disposal on the US Department of Energy's Oak Ridge Reservation. Geophysical log response was calibrated to borehole geology using the drill core. Subsequently, the logs were used to identify fractures and fractured zones and to characterize the hydrologic activity of such zones. Results of the study were used to identify zones of ground water movement and to select targets for subsequent piezometer and monitoring well installation. Neutron porosity, long- and short-normal resistivity, and density logs exhibit anomalies only adjacent to pervasively fractured zones and rarely exhibit anomalies adjacent to individual fractures, suggesting that such logs have insufficient resolution to detect individual fractures. Spontaneous potential, single point resistance, acoustic velocity, and acoustic variable density logs, however, typically exhibit anomalies adjacent to both individual fractures and fracture zones. Correlation is excellent between fracture density logs prepared from the examination of drill core and fractures identified by the analysis of a suite of geophysical logs that have differing spatial resolution characteristics. Results of the study demonstrate the importance of (1) calibrating geophysical log response to drill core from a site, and (2) running a comprehensive suite of geophysical logs that can evaluate both large- and small-scale rock features. Once geophysical log responses to site-specific geological features have been established, logs provide a means of identifying fracture zones and discriminating between hydrologically active and inactive fracture zones. 9 figs.

10928 **(DOE/CH/10268—1) Penobscot Indian Nation: Final technical report.** (Penobscot Indian Nation, Old Town, ME (USA)). 18 Sep 1986. Contract FG02-86CH10268. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003870.

The Penobscot Nations' comment document is composed of six (6) major sections which were researched by the various consultants (names and titles listed in the document): (A) Legal, (B) Cultural, (C) Geologic, (D) Hydrogeologic, (E) Environmental, and (F) General.

10929 **(DOE/LLW—59T) The 1985 state-by-state assessment of low-level radioactive wastes shipped to commercial disposal sites.** (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1986. Contract AC07-76ID01570. 134p. NTIS, PC A07/MF A01. File Number DE87004149.

The 1985 report uses the volume of low-level waste reported as received at each commercial disposal site as the national baseline figure. A volume of 75,909 m^3 of radioactive waste containing 748,903 Ci of activity was reported disposed at the commercial sites in 1985. The distribution of these waste volumes by disposal site is presented in Table 1. Table 2 displays typical radionuclides in low-level wastes by sector. Table 3 presents predominant waste forms associated with low-level waste by sector. The total volume and curie values tabulated for each state were obtained directly from the commercial disposal site operators. The total is the sum of the volume and radioactivity reported by Chem Nuclear and US Ecology for each state. Figure 1 displays the disposal capacity remaining at Barnwell, Richland, and Beatty commercial disposal sites as of December 31, 1985. Summary information on commercial nuclear power plant wastes was obtained from semiannual waste and effluent reports submitted to the NRC in accordance with the NRC Regulatory Guide 1.21. Where reported data were not available, data were obtained by communication with the utility. Nonreactor waste volumes are actual amounts recorded as received at the commercial waste repositories in 1985. Waste categories are defined as academic, medical, government, and industrial. New to the 1985 report is Appendix B, 1985 Assessments Listed By Ratified Compacts, as well as the proposed Western and Appalachian compacts. Inclusion of the most accurate information available from all sources has resulted in an improved national waste distribution profile of generator sectors. 11 refs.

10930 **(DOE/NE/44345—1-00/86) Crystalline Repository Project: Final technical report for the project beginning July 18, 1983 and ending September 30, 1986.** (Georgia Dept. of Natural Resources, Atlanta (USA)). 1986. Contract FG02-83NE44345. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002781.

This report is a summary of the research performed, data analyzed and technical reviews conducted by Georgia's Environmental Protection Division (EPD) as part of a grant from the US Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), Crystalline Repository Project (CRP), from July 18, 1983 through September 30, 1986.

10931 **(DOE/WIPP—86-004) Waste Isolation Pilot Plant: Annual hydrogeologic data report, 1985/1986.** Winstanley, D.J.; Carrasco, R.C. (Westinghouse Electric Corp., Carlsbad, NM (USA). Technology Development Dept.). Oct 1986. Contract AC04-86AL31950. 267p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87004223.

Hydrologic data collected at the US Department of Energy's Waste Isolation Pilot Plant in southeastern New Mexico are presented. Two compiled topographic maps are also included at a scale of 1 inch equals 1 mile. The first map covers approximately 1400 square miles and the second covers approximately 450 square miles and includes selected hydrologic well location information. Water level measurements collected from 56 wells during the first half of calendar year 1986 are presented. A number of wells are completed in multiple zones separated by Production-Injection Packers, allowing measurements to be taken from more than one zone. Nine water level measurements were collected of the Magenta Dolomite Member of the Rustler Formation, 45 of the Culebra Dolomite Member of the Rustler Formation, 3 of the Rustler/

Salado contact residuum, 2 of the Bell Canyon Formation, 1 of the Castile Formation, and 2 from unknown zones. Pressure recovery and flow rate data are presented from pumping at well H-12 during August 1985. Pumping continued for 9 days at an average flow rate of approximately 17 gallons per hour. Recovery data was collected for five days after termination of pumping. No data interpretation is provided. Well configuration data are provided for 67 wells in the vicinity of the WIPP site. The information is compiled from published reports, memos, field notes, and other documented sources of which a detailed listing is provided. Each well record includes general well information, casing/hole/screen data, completion interval data, packer or plug installations, and comments. Geophysical logs from 22 hydrologic test wells were reinterpreted and the picks are presented for the following stratigraphic markers: the Rustler/Salado contact residuum; base and top of the Culebra Dolomite; and base and top of the Magenta Dolomite. 10 refs., 8 figs., 4 tabs.

10932 (DOE/WIPP—86-010) Waste Isolation Pilot Plant design validation: Final report. (Bechtel National, Inc., San Francisco, CA (USA)). Oct 1986. Contract AC04-78AL10751. 572p. NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE87003412.

This report provides documentation of actual underground conditions encountered as they relate to the design criteria, design bases, and design configurations for the reference design of the underground openings. It includes a selection of the more essential data collected during the design validation effort and an interpretation of these data.

10933 (DOE/WIPP—86-010-App.) Waste Isolation Pilot Plant design validation: Final report, Appendices. (Bechtel National, Inc., San Francisco, CA (USA)). Oct 1986. Contract AC04-78AL10751. 895p. NTIS, PC A99. File Number DE87003365.

This volume is comprised of the following appendices: DOE stipulated agreement with State of New Mexico (partial); geologic correlations; mathematical simulation of underground in situ behavior; C & SH shaft geologic logs and maps; waste shaft geologic logs and maps; exhaust shaft geologic log; test rooms geologic maps and sections; drift cross sections; facility level geologic core hole logs; geomechanical instrumentation data plots; and analytical data plots.

10934 (DOE/WM/46642—T3) Vermont's involvement with the DOE's high-level radioactive waste disposal crystalline repository project. Final technical report, January 1-September 30, 1986. (Vermont Environmental Conservation Agency, Montpelier (USA). Office of the State Geologist). Sep 1986. Contract FG02-81WM46642. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002041.

The US Department of Energy (DOE) is charged with siting a second repository for the disposal of highly radioactive nuclear wastes. Because of this siting process, the DOE has looked to localities in 17 states in the eastern US for possible sites in crystalline rock. During the beginning of the progress report period, crystalline rocks in Vermont were under consideration as sites for further study. Vermont, through the Vermont State Geologist's Office, was closely involved with the DOE program during this period. Our main function has been to review DOE reports; attend DOE workshops and meetings; and inform the Vermont public, with the help of the DOE, about the high-level nuclear waste repository siting process. Nine sites in Vermont were under consideration during the Regional Characterization Phase until January 16, 1986. Because of this fact, there was considerable public interest in this program. Upon release of the Draft Area Recommendation Report, Vermont crystalline rock bodies were dropped from consideration. A site in New Hampshire and two sites in Maine remained on the list. Because of the draft status of the report and the possibility that a site 20 miles from the Vermont border in New Hampshire could remain as a selected site, Vermont has stayed active and interested. Two briefings and hearings were held in the State during the comment period January 16 through April 16, 1986. A thorough review of the Draft Area Recommendation Report was completed using reviewers from our Office, State agencies, outside experts, and citizen groups. With the announcement on May 28, 1986 of the suspension of the second repository siting process in crystalline rocks, our Office has worked toward closing out our active involvement.

10935 (DP-MS—86-150-Rev.6-86) Incorporating functional requirements into the structural design of the Defense Waste Processing Facility. Hsiu, F.J.; Ng, C.K.; Almuti, A.M. (Bechtel National, Inc., San Francisco, CA (USA)). 1986. Contract AC09-76SR00001. 13p. (CONF-861097—3-Rev.6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002648.

From ASCE national meeting on computing in civil engineering; Boston, MA, USA (27 Oct 1986).

Vitrification Building-type structures have unique features and design needs. The structural design requires new concepts and custom detailing. The above special structural designs have demonstrated the importance of the five design considerations listed in the introduction. Innovative ideas and close coordination are required to achieve the design objectives. Many of these innovations have been applied to the DWPF facility which is a first of a kind.

10936 (EPRI-NP—4886) TMI-2 sludge separation and packaging analyses and conceptual design: Final report. Larson, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 72p. NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87003331.

A study was conducted by Battelle, Pacific Northwest Laboratories (BNW) for the Electric Power Research Institute (EPRI) to evaluate cost-effective technologies for radioactive waste (radwaste) sludge recovery and packaging at utility power reactors. As a frame of reference, a process technology using the auxiliary building sump (ABS) and sump tank (ABT) sludges at GPU Nuclear Corporation's Three Mile Island-Unit 2 (TMI-2) was selected for conceptual design. Sludge removal from the sump and sump tank was not included in the study. Based on criteria provided by TMI-2 staff and used by nuclear utilities in general, sedimentation followed by vendor cement solidification of the sludge was recommended from the nine conceptual approaches evaluated. A conceptual design and equipment cost estimate were provided for the recommended system. Sludge characterization data and laboratory process development data are provided to form a basis for process design.

10937 (EPRI-NP—4954) Chemical cleaning waste disposal: Final report. Snow, A.L. (Duke Power Co., Charlotte, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 100p. Research Reports Center, Box 50490 Palo Alto, CA 94303. File Number TI87920178.

The accumulation of corrosion products is leading to degradation in some operating nuclear steam generators. Several utilities are considering application of the generic chemical cleaning process developed by the Steam Generator Owners Group to achieve removal of the corrosive sludge and debris. Logistical support is provided to assist in planning for disposal of the resulting solvent and rinse wastes. The objectives of this report are: to characterize the wastes generated in each step of the generic steam generator chemical cleaning process; to identify and evaluate currently available waste processing and disposal methods; to recommend the most viable disposal methods.

10938 (FMPC—2040-Rev.1) Feed Materials Production Center Waste Management Plan. Watts, R.E.; Allen, T.; Castle, S.A.; Hopper, J.P.; Oelrich, R.L. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 31 Dec 1986. Contract AC05-86OR21600. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87003986.

In the process of producing uranium metal products used in Department of Energy (DOE) defense programs at other DOE facilities, various types of wastes are generated at the Feed Materials Production Center (FMPC). Process wastes, both generated and stored, are discussed in the Waste Management Plan and include low-level radioactive waste (LLW), mixed hazardous/radioactive waste, and sanitary/industrial waste. Scrap metal waste and wastes requiring special remediation are also addressed in the Plan. The Waste Management Plan identifies the comprehensive programs developed to address safe storage and disposition of all wastes from

past, present, and future operations at the FMPC. Waste streams discussed in this Plan are representative of the waste generated and waste types that concern worker and public health and safety. Budgets and schedules for implementation of waste disposition are also addressed. The waste streams receiving the largest amount of funding include LLW approved for shipment by DOE/ORO to the Nevada Test Site (NTS) (MgF_2, slag leach filter cake, and neutralized raffinate); remedial action wastes (waste pits, K-65 silo waste); thorium; scrap metal (contaminated and noncontaminated ferrous and copper scrap); construction rubble and soil generated from decontamination and decommissioning of outdated facilities; and low-level wastes that will be handled through the Low-Level Waste Processing and Shipping System (LLWPSS). Waste Management milestones are also provided. The Waste Management Plan is divided into eight major sections: Introduction; Site Waste and Waste Generating Process; Strategy; Projects and Operations; Waste Stream Budgets; Milestones; Quality Assurance for Waste Management; and Environmental Monitoring Program.

10939 (INIS-mf—10514, pp 1) **Geophysical investigations on the Vaalputs radioactive waste disposal facility in the Republic of South Africa.** Anderson, N.J.B.; Faurie, J.N. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Aug 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87700294. (CONF-860909—Absts.).

From Conference on the treatment and containment of radioactive wastes and disposal in arid environments (Radwaste '86); Cape Town, South Africa (7 Sep 1986).

10940 **(MLM—3404) A simplified system for steady state process simulation.** Mills, T.K. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Dec 1986. Contract AC04-76DP00053. 59p. NTIS, PC A04/MF A01. File Number DE87004027.

The system described in this report represents an attempt to apply the function of industrial flow sheet simulators to tritium processing applications. To overcome some of the difficulties associated with the use of larger simulation packages, report formats have been designed to accommodate wide ranges of component concentrations; and physical property data requirements have been designed around commonly available data. The simulation system includes a predefined structure for storage of stream and component data, unit operation block parameters, and the other data needed to describe a simulation. Other support subroutines, which are needed to perform computations common to different unit operation subroutines, are included, along with some of the more common unit operation modules. To perform a simulation, the user codes an executive routine that calls the appropriate support and unit operation subroutines - as well as any additional support or unit operation subroutines not already part of the system. This code is then compiled and linked to a library, which contains the existent parts of the system, to produce an executable program. This program is run, with the user's data file as input, to compute the steady state performance of the flow sheet being simulated. The existent part of the system is coded in Microsoft FORTRAN-77, which should be largely compatible with other FORTRAN compilers. The simulation system has been compiled and placed in a library which is usable by a Microsoft linkage editor on an IBM PC.

10941 **(NAGRA-NGB—85-01) Swiss nuclear projects: Concepts and overview of the Project Guarantee 1985.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jan 1985. 325p. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE87900398.

The validity of the operational licenses of the existing Swiss nuclear powre plants (NPP) Beznau I and II, Muehleberg, Goesgen and Leibstadt after December 31, 1985 is, because of official requirements, dependent on the demonstration of permanent, safe management and final disposal of radioactive waste. For this purpose, the NPP companies have to prepare a so-called "guarantee project" and present this to the Bundesrat for review. The appropriate investigations and research have been carried out by Nagra (National Cooperative for the Storage of Radioactive Waste). The 1985 Project Gewaehr (Guarantee) is described in an eight volume report NGB 85-01 to 85-08 and individual research projects are reported on in separate NTB-series reference reports. The present volume NGB 85-01 takes the form of a self-contained project overview in which the concepts for nuclear waste management are described, the contents of the remaining volumes NGB 85-02 to 85-08 are summarized and conclusions are drawn from Project Gewaehr 1985. The main task of Project Gewaehr 1985, can be defined by three points: sufficiently detailed projects must cover the technical feasibility of a final repository in Switzerland; by means of safety analyses it must be shown quantitatively that final disposal of all categories of radioactive waste is currently realizable based on present-day knowledge and available technology without exposing the population to unreasonable radiation risks (demonstration of long-term safety); the data put into the safety analyses must be corroborated by investigations in Switzerland or abroad or must, in some other way, conform to the technical and scientific state of knowledge. The data include geological, hydrogeological and material-technical parameters and the behavior of radionuclides in the geo- and biosphere as determined by their physical and chemical properties.

10942 **(NAGRA-NTB—84-28) Evaluation of satellite image lineament patterns in Raume Baden-Frick-Laufenburg-Zurzach.** Isler, A. (Kellerhals (P.) und Haefeli (Ch.) (Dres.), Geologen, Bern (Switzerland)). Aug 1984. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900399.

Satellite images often show a dense network of linear elements. The effective meaning of these lineament patterns is still under discussion, especially as to their significance in structural interpretations. In northern Switzerland, a detailed comparison of Landsat images with topographic and geological maps, and aerial photographs - all on a scale of 1:25,000 - has proved that most of the lineaments delineated in Landsat images appear to represent "bright/dark contrasts" produced by morphology, vegetation and human activity. No conclusive evidence as to tectonic origins were observed. Nevertheless, tectonically influenced origins of recent drainage patterns cannot be neglected. However, the evaluation of potential repository sites in northern Switzerland must be based on detailed field work whereas tectonic lineament pattern derived from satellite images should be considered only as informations of secondary or supplementary importance.

10943 **(NUREG/CR—4693) Assessment of radionuclide vapor-phase transport in unsaturated tuff.** Smith, D.M.; Updegraff, C.D.; Bonano, E.J.; Randall, J.D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 56p. (SAND—86-1598). NTIS, PC A04/MF A01 - GPO. File Number TI87003446.

This report describes bounding calculations performed to investigate the possibility of radionuclide migration in a vapor phase associated with the emplacement of high-level waste canister in unsaturated tuff formations. Two potential radionuclide transport mechanisms in the vapor phase were examined: aerosol migration and convection/diffusion of volatile species. The former may have significant impact on the release of radionuclides to the accessible environment as the concentration in the aerosols will be equal to that in the ground water. A conservative analysis of air diffusion in a stagnant liquid film indicated that for all expected repository conditions, aerosol formation is not possible. The migration of volatile species was examined both in the vicinity of a waste canister and outside the thermally disturbed zone. Two-dimensional (radial) and three-dimensional (radial-vertical) coupled heat transfer-gas flow-liquid flow simulations were performed using the TOUGH computer code. The gas flow rate relative to the liquid flow rate predicted from the simulations allowed calculations of mobility ratios due to convection which led to the conclusion that, except for the immediate region near the canister, transport in the liquid phase will be dominant for radionuclides heavier than radon. Near the waste canister, iodine transport may also be important in the vapor phase. Bounding calculations for vertical mobility ratios were carried out as a function of saturation. These calculations are conservative and agree well with the two-dimensional simulations. Based on this analysis, it is clear that vapor-phase transport will not be important for radionuclides such as cesium and heavier species. Vapor trans-

port for iodine may play a role in the overall release scenario depending on the particular repository conditions.

10944 (OEFZS—4373) Description of the Seibersdorf incineration plant for low level waste. Chalupa, G.; Petschnik, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Hauptabteilung Abfallverarbeitung). Sep 1986. 46p. (AV—18/86). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700449.

After a description of the design and the construction principles of the incinerator building, the furnace and its attached auxilary devices are explained. The incinerator is layed out for low level wastes. It has a vertical furnace, operates with discontinuous feeding for trashes with heat-values between 600 and 10,000 kcal/kg waste. The maximum throughput amounts 40 kg/h. The purification of the off-gas is guaranteed by a multistage filter system: 2 stages with ceramic candles, cooling column and a HEPA-filter system. The control of the off-gas cleaning is carried out by a stack instrumentation, consisting of an aerosol-, gas-, Iodine- and Tritium-monitor; the building is surveilled by doserate- and aerosolmonitors.

10945 (OEFZS—4374) Conditioning of low-level radioactive waste at the Research Centre Seibersdorf. Chalupa, G.; Petschnik, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Hauptabteilung Abfallverarbeitung). Sep 1986. 24p. (AV—19/86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700450.

The conditioning (solidification) of LLW at the Austrian Research Centre Seibersdorf are explained. In first part of this paper the comentation of ashes are described and criteria for the application of recipes for conditioning, quality inspection, determination of leaching rates are given. Enclosed to that some figures show you the installed equipment and the handling for conditioning of LLW at the Research Centre.

10946 (ORNL/EIS—154/V7) Nuclear facility decommissioning and site remedial actions: A selected bibliography: Volume 7. Owen, P.T.; Michelson, D.C.; Knox, N.P.; Fowler, J.W. (Oak Ridge National Lab., TN (USA)). Sep 1986. Contract AC05-84OR21400. 468p. (RLO/SFM—80/5-Vol.7). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE87002853.

The 644 abstracted references on nuclear facility decommissioning, uranium mill tailings management, and site remedial actions constitute the seventh in a series of reports prepared annually for the US Department of Energy's Remedial Action Programs. Foreign and domestic literature of all types - technical reports, progress reports, journal articles, conference papers, symposium proceedings, theses, books, patents, legislation, and research project descriptions - has been included. The bibliography contains scientific (basic research as well as applied technology), economic, regulatory, and legal literature pertinent to the US Department of Energy's remedial action program. Major chapters are (1) Surplus Facilities Management Program, (2) Nuclear Facilities Decommissioning, (3) Formerly Utilized Sites Remedial Action Program, (4) Facilities Contaminated with Naturally Occurring Radionuclides, (5) Uranium Mill Tailings Remedial Action Program, (6) Grand Junction Remedial Action Program, (7) Uranium Mill Tailings Management, (8) Technical Measurements Center, and (9) General Remedial Action Program Studies. Chapter sections for chapters 1, 2, 5, and 7 include Design, Planning, and Regulations; Environmental Studies and Site Surveys; Health, Safety, and Biomedical Studies; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience; and General Studies. References are arranged alphabetically by leading author. Those references having no individual author are listed by corporate affiliation or by publication description. Indexes are provided for author, corporate affiliation, title word, publication description, geographic location, and keywords. The appendix contains a list of frequently used acronyms and abbreviations.

10947 (ORNL/TM—9680-Pt.3) Fixation of waste materials in grouts: Part 3, Equation for critical flow rate. Tallent, O.K.; McDaniel, E.W.; Spence, R.D.; Godsey, T.T.; Dodson, K.E. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004028.

Critical flow rate data for grouts prepared from three distinctly different nuclear waste materials have been correlated. The wastes include Oak Ridge National Laboratory (ORNL) low-level waste (LLW) solution, Hanford Facility waste (HFW) solution, and cladding removal waste (CRW) slurry. Data for the three wastes have been correlated with a 0.96 coefficient of correlation by the following equation: log V/sub E/ = 0.289 + 0.707 log μ/sub E/, where V/sub E/ and μ/sub E/ denote critical flow rate in m^3/min and apparent viscosity in Pa.s, respectively. The equation may be used to estimate critical flow rate for grouts prepared within the compositional range of the investigation. 5 refs., 4 figs., 7 tabs.

10948 (ORNL/TM—9865) Proceedings of the first geochemical workshop on shale: Environmental Sciences Division publication No. 2845. Brookins, D.G.; Stow, S.H. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87004035.

This report represents the outcome of the first workshop dealing with geochemical research needs for a shale-hosted repository for disposal of high-level nuclear waste. The workshop was held at the University of New Mexico in 1985 and was attended by scientists representing academia, national laboratories, and the federal government. Research needs are grouped into three major categories: (1) characterization of baseline conditions, (2) radioelement behavior: ambient conditions, and (3) effect of waste emplacement. Within each category, specific needs are identified and discussed. For each, statements of justification, approach, and man-power requirements are presented. General levels of priorities are established for each research need.

10949 (ORNL/TM—10299) Initial formulation results for in situ grouting of a waste trench at ORNL Site No. 6. Tallent, O.K.; McDaniel, E.W.; Spence, R.D.; Godsey, T.T. (Oak Ridge National Lab., TN (USA)). Jan 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004046.

An investigation is being conducted by the Chemical Technology Division to assist the Environmental Sciences Division in developing a grout formulation for use in testing in situ grouting in a waste trench at ORNL Site 6. This final report satisfies the milestone of Subtack 12 entitled, "Low Level Waste (LLW) Trench Grouting Assessment," which was initially issued as RAP-86-7, December 31, 1985. Grouts prepared from dry-solid blends containing Type I Portland cement, ASTM Class C or Class F fly ash, and bentonite, mixed water at ratios of 10 to 15 lb/gal, were evaluated. The grouts prepared with ASTM Class C fly ash exhibited significantly better properties than those prepared with ASTM Class F fly ash. The grouts containing ASTM Class C fly ash satisfy tentative performance criteria for the project. 8 refs., 7 tabs.

10950 (PB—87-100467/XAB) Thermomechanical analysis of some proposed schemes for radioactive waste disposal. Research report. Carter, J.P.; Booker, J.R. (Sydney Univ. (Australia). School of Civil and Mining Engineering). Sep 1985. 31p. (R—508). NTIS, PC PC E03/MF E01.

Solutions are presented for the steady-state, thermomechanical response of an elastic half space containing either a vertical line source or a horizontal disc-shaped source of heat. It is suggested that these solutions may be useful for predicting the long-term behavior of rock masses containing nuclear-waste repositories; the solution for the line source being appropriate for the disposal of hot wastes in deep boreholes and the solution for the disc-shaped source being applicable to disposal in underground galleries of significant lateral extent. It is demonstrated that, in both cases, the surface of the rock mass will heave and that there is potential for cracking of the rock overlying the repositories because of tensile stress changes induced in the region near the surface. Typical

values of these quantities were calculated for a rock-mass-like granite.

10951 **(PNL—6051) Engineered sorbent barriers for low-level waste disposal.** Freeman, H.D.; Mitchell, S.J.; Buelt, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 61p. NTIS, PC A04/MF A01. File Number DE87004053.

The Engineered Sorbent Barriers Program at Pacific Northwest Laboratory is investigating sorbent materials to prevent the migration of soluble radio nuclides from low-level waste sites. These materials would allow water to pass, preventing the bathtub effect at humid sites. Laboratory studies identifield promising sorbent materials for three key radionuclides: for cesium, greensand; for cobalt, activated charcoal; and for strontium, synthetic zeolite or clinoptilolite. Mixtures of these sorbent materials were tested in 0.6-m-diameter columns using radioactive leachates. To simulate expected worst-case conditions, the leachate solution contained the radionuclides, competing cations, and a chelating agent and was adjusted to a pH of 5. A sorbent barrier comprised of greensand (1 wt%), activated charcoal (6 wt%), synthetic zeolite (20 wt%), and local soil (73 wt%) achieved the decontamination factors necessary to meet the regulatory performance requirements established for this study. Sorbent barriers can be applied to shallow-land burial, as backfill around the waste or engineered structures, or as backup to other liner systems. 7 refs., 14 figs., 12 tabs.

10952 **(SAND—86-0369) Mass balance computation in SAGUARO.** Baker, B.L.; Eaton, R.R. (Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. 33p. NTIS, PC A03/MF A01. File Number DE87003964.

This report describes the development of the mass balance subroutines used with the finite-element code, SAGUARO, which models fluid flow in partially saturated porous media. Derivation of the basic mass storage and mass flux equations is included. The results of the SAGUARO mass-balance subroutine, MASS, are shown to compare favorably with the linked results of FEMTRAN. Implementation of the MASS option in SAGUARO is described. Instructions for use of the MASS option are demonstrated with the three sample cases.

10953 **(SAND—86-7157) The ISHTE [In-Situ Heat Transfer Experiment] lander: Final report.** Olson, L.O.; Harrison, J.G. (Washington Univ., Seattle (USA). Applied Physics Lab.; Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003960.

This report describes the design and development of a sea floor lander constructed to support the In-Situ Heat Transfer Experiment (ISHTE). The work entailed fabricating and testing a steel space frame that would support and accurately position delicate instruments which would monitor a heat source driven into the sediments of the deep ocean. This lander is capable of being (1) transported from Seattle to Hawaii and back several times; (2) deployed from a ship at sea; (3) operated on the sea floor to field delicate experimental equipment; and (4) recovered for retrofit to support a one-year experiment on the sea floor.

10954 **(SAND—86-7171) [In-Situ Heat Transfer Experiment (ISHTE): Final report on contract 52-5769.** Miller, V.W.; Miller, J.B.; Olson, L.O. (Washington Univ., Seattle (USA). Applied Physics Lab.; Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003959.

This report describes some of the design and development work performed by the Applied Physics Laboratory in support of the In-Situ Heat Transfer Experiment (ISHTE). The work entailed fabrication and testing of a sensor implantment and retraction system, a retraction system for an electric heater, two electrical junction boxes, and a 130-volt, pressure-compensated battery pack. ISHTE was to implant a heat source in the clay sediments of the deep ocean and monitor the effects of the heat on the sediment for one year. At the end of the experiment, the equipment and samples of the heat-affected sediment were to be recovered for study. This experiment is part of the near-field studies of the Subseabed Disposal Program which is funded by the Department of Energy.

10955 **(SAND—86-7173) ISHTE [In-Situ Heat Transfer Experiment] rigging: Final report.** Miller, V.W.; Olson, L.O. (Washington Univ., Seattle (USA). Applied Physics Lab.; Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003961.

This report describes some of the design and development work performed by the Applied Physics Laboratory in support of the In-Situ Heat Transfer Experiment (ISHTE). The work entailed the development of handling systems, back-up recovery systems, and back-up data recovery equipment for the ISHTE platform. ISHTE will implant a heat source in the clay sediments of the deep ocean and monitor the effects of the heat on the sediment for one year. At the end of the experiment, the equipment and samples of the heat-affected sediment will be recovered for study. This experiment is part of the near-field studies of the Sub-seabed Disposal Program which is funded by the Department of Energy.

10956 **(USGS-OFR—86-558) Bibliography of reports by US Geological Survey personnel on studies at the Nevada Test Site and the Waste Isolation Pilot Plant Site, New Mexico, January 1, 1985 to December 31, 1985.** Glanzman, V.M. (Geological Survey, Denver, CO (USA)). 1986. Contract AI08-76DP00474;AI08-78ET44802. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003843.

Reports listed in this bibliography include information on underground nuclear testing and waste management projects at the NTS (Nevada Test Site) and radioactive waste projects at the WIPP (Waste Isolation Pilot Plant) site, New Mexico. The bibliography is divided into three categories: (1) reports regarding underground nuclear testing; (2) waste management projects at the NTS; and (3) waste management studies at the WIPP site. Reports are listed in each category by publication outlet. The USGS-474 series reports pertain to underground nuclear testing studies and are cross referenced to administrative (or in-house) series (for example, USGS-474-319 is cross referenced as NTS-265). The administrative series are used to break down the USGS-474 series for more specific area identification. A list of cross references is shown on page 5. Most reports issued in the USGS-474 series are available to the public through the NTIS (National Technical Information Service, US Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

10957 **(USGS-PP—1323) Stratigraphic and volcano-tectonic relations of Crater Flat Tuff and some older volcanic units, Nye County, Nevada.** Carr, W.J.; Byers, F.M. Jr.; Orkild, P.P. (Geological Survey, Reston, VA (USA)). 1986. Contract AI08-78ET44802. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86015043.

The Crater Flat Tuff is herein revised to include a newly recognized lowest unit, the Tram Member, exposed at scattered localities in the southwest Nevada Test Site region, and in several drill holes in the Yucca Mountain area. The overlying Bullfrog and Prow Pass Members are well exposed at the type locality of the formation near the southeast edge of Crater Flat, just north of US Highway 95. In previous work, the Tram Member was thought to be the Bullfrog Member, and therefore was shown as Bullfrog or as undifferentiated Crater Flat Tuff on published maps. The revised Crater Flat Tuff is statigraphically below the Topopah Spring Member of the Paintbrush Tuff and above the Grouse Canyon Member of the Belted Range Tuff and is approximately 13.6 m.y. old. Drill holes on Yucca Mountain and near Fortymile Wash penetrate all three members of the Crater Flat as well as an underlying quartz-poor unit. Although the rocks are poorly exposed, geophysical and geologic evidence to date suggests that (1) the source of the Crater Flat Tuff is a caldera complex in the Crater Flat area between Yucca Mountain and Bare Mountain, and (2) there are at least two cauldrons within this complex - one probably associated with eruption of the Tram, the other with the Bullfrog and Prow Pass Members. The complex is named the Crater Flat-Prospector Pass caldera complex. The northern part of the Yucca Mountain area is suggested as the general location of the source of pre-Crater

Flat tuffs, but a caldera related to the Lithic Ridge Tuff has not been specifically identified. 23 refs., 18 figs., 1 tab.

10958 **Application of an automated procedure for adding a comprehensive sensitivity calculation capability to the ORIGEN2 point depletion and radioactive decay code.** Worley, B.A.; Wright, R.Q.; Pin, F.G.; Harper, W.V. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN). *Nuclear Science and Engineering;* **94**: No. 2, 180-191(Oct 1986).

An application of an automated procedure called GRESS for adding derivative-taking capability to FORTRAN computer codes is presented. The efficiency and usefulness of GRESS for enhancing the point depletion and radioactive decay code ORIGEN2 are discussed. A new version of ORIGEN2 is now available that has the capability of calculating first derivatives and sensitivities of any variable in the code with respect to any other variable. The capabilities of the enhanced version, ORIGEN2G, are exemplified by its use in a sensitivity study of a high-level nuclear waste disposal problem. By using GRESS, the enhanced version ORIGEN2G was produced, tested, and verified in 2 man-months compared to an estimated 1 to 2 man-yr of effort to program a code with comparable capabilities.

10959 **Prescriptive approach - the link between the performance assessments of the US DOE projects and regulatory requirements of NRC and EPA.** Van Luik, A.E.; Eisenberg, N.A.; Alexander, D.H. (Pacific Northwest Laboratory, Richland, WA, USA; US Department of Energy, Washington, DC). pp 61-77 of System performance assessments for radioactive waste disposal. Proceedings of the NEA Workshop. Paris, France; OECD (1986). (CONF-8510131—).

From Workshop on systems performance assessments for the safety of radioactive waste disposal; Paris, France (22 Oct 1985).

The US regulatory approach to high-level radioactive waste and spent nuclear fuel disposal has been called "prescriptive". This is because standards, requirements, and criteria that the implementing agency must follow, have been prescribed by the regulatory agencies, and are largely based on conceptual research and preliminary performance assessments performed by or for these agencies. This approach, and its resulting regulations, reflects the US institutional structure, and does not differ greatly from the regulatory goals and approaches being used within the OECD community of nations. The linkages between US performance assessment strategies and features of the US high-level waste and spent fuel disposal regulations are briefly explored.

10960 **Link between laboratory/field observations and models.** Cole, C.R.; Foley, M.G. (Pacific Northwest Laboratory Richland, WA, USA). pp 127-140 of System performance assessments for radioactive waste disposal. Proceedings of the NEA Workshop. Paris, France; OECD (1986). (CONF-8510131—).

From Workshop on systems performance assessments for the safety of radioactive waste disposal; Paris, France (22 Oct 1985).

The various linkages in system performance assessments that integrate disposal program elements must be understood. The linkage between model development and field/laboratory observations is described as the iterative program of site and system characterization for development of an observational-confirmatory data base. This data base is designed to develop, improve, and support conceptual models for site and system behavior. The program consists of data gathering and experiments to demonstrate understanding at various spatial and time scales and degrees of complexity. Understanding and accounting for the decreasing characterization certainty that arises with increasing space and time scales is an important aspect of the link between models and observations. The performance allocation process for setting performance goals and confidence levels, coupled with a performance assessment approach that provides these performance and confidence estimates, will determine when sufficient characterization has been achieved. At each iteration, performance allocation goals are reviewed and revised as necessary. The updated data base and appropriate performance assessment tools and approaches are utilized to identify and design additional tests and data needs necessary to meet current performance allocation goals.

10961 **H.R. 5423: a bill to amend the Nuclear Waste Policy Act of 1982 to suspend the site characterization process, and for other purposes. Introduced in the House of Representatives, Ninety-Ninth Congress, Second Session, August 13, 1986.** Washington, DC; Government Printing Office (1986). 14p.

The Nuclear Waste Policy Amendments of 1986 amend the Nuclear Waste Policy Act of 1982 to suspend the site characterization process specifically to withhold any funds for sites nominated as repositories. A Federal Nuclear Waste Board will implement the Act. The revised siting guidelines will recognize different geologic media in establishing siting criteria. The Board will also establish a panel to analyze disposal capacity and establish the need for a second repository, determine whether such capacity is technologically feasible, and to rank options.

10962 **Partitioning of cesium in phases produced by grouted waste injection.** Stinton, D.P.; McDaniel, E.W.; Weeren, H.O. (Oak Ridge National Lab., TN). *Materials Research Society Symposia Proceedings;* **26**: 521-526(1984). Contract W-7405-ENG-26.

Phases present in injected grouts were characterized by use of optical microscopy, scanning electron microscopy, x-ray diffraction, and β-γ autoradiography. A laboratory-produced sample containing 1 wt % stable cesium and an actual grout sheet obtained by core drilling were examined. The phases present in these samples were identified, and cesium was found to be absorbed almost entirely by illite clay agglomerates. These clay agglomerates were tightly bound within the grout structure by hydrated calcium silicates. The β-γ autoradiography of the core-drilled sample verified that cesium and other radionuclides were trapped within the 20-year-old grout and had not migrated into trapped shale fragments. 9 references, 3 figures, 1 table.

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REFER ALSO TO CITATION(S) 12268, 12300, 12308, 12334

10963 **(HW—49195) Turbulent diffusion of river contaminants.** Norton, H.T. (General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation). 25 Mar 1957. Contract AC06-76RL01350. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010090.

As water from the Columbia River passes through the HAPO nuclear reactors, in addition to absorbing heat generated by the controlled fission process, the impurities in the water become radioactive through irradiation. Following a retention period to allow cooling and radioactive decay, the water is discharged into the river through submerged pipes. Once in the river, the residual heat and radioactivity is dispersed by turbulent diffusion and downstream conveyance. The rate and pattern of this dispersion are of prime concern due to the effect of the heat on the aquatic life in the river and on the productive capacity of downstream reactors. Of equal concern is the effect of the residual radioactivity on the aquatic life and on the populus relying on the Columbia River for drinking water supplies. For these reasons it was imperative that an effort be made to define the turbulent diffusion of this residual heat and radioactivity. Both a theoretical and an empirical approach were pursued toward defining the turbulent diffusion process encountered in the Columbia River. The merits and limitations of each approach are discussed. Although no solution was obtained for the differential equation encountered in the theoretical development, its derivation is included for the benefit of those interested in further study of this or a similar problem. The empirical approach is completely outlined and gives an adequate fit to the available data. However, it cannot be extended to conditions not defined by the data without additional experimental work which is outlined. 9 refs.

10964 **(NP—7900159) INTRACOIN study: Appendices.** (Kemakta Konsult AB, Stockholm (Sweden); Swedish Nuclear Power Inspectorate, Stockholm). [1986]. 323p. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

Individual appendices from the International Nuclide Transport Code Intercomparison (INTRACOIN) are abstracted separately. (LM)

10965 (NP—7900159, pp 13, Appendix 2:1) **INTRACOIN, level 2: Case 2A: A one-dimensional approach.** Hadermann, J.; Roesel, F. (Swiss Federal Institute for Reactor Research, Wuerenlingen). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

We present the results of a one-dimensional approach to the two-dimensional level 2 case 2A benchmark problem. Such an undertaking seems worthwhile since one-dimensional models are extensively used, including our own RANCH and RANCHN, for reasons of simplicity and economy. The questions to be addressed are: to what extent can a two-dimensional situation be approximated with reasonable expenditure by a one-dimensional transport model, and how dependent are the results from particular approach and parameters chosen.

10966 (NP—7900159, pp 57, Appendix 2:2) **INTRACOIN, level 2: Benchmark calculations with code SWIFT.** Buetow, E.; Heredia, L.; Struck, S. (Technische Universitaet Berlin, Germany). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

This paper describes the work performed at the Institute for Nuclear Engineering (Institut fuer Kerntechnik) at the Technical University Berlin (Technische Universitaet Berlin) for the level 2 of the INTRACOIN study using the SWIFT code. The aim in Level 2 is to test the capabilities of the codes to describe in-situ measurements. The benchmark-cases for level 2 are divided into problems to show the radionuclide migration in fractured geologic rocks and in porous geologic sediments. This report describes only the calculations for the porous media cases.

10967 (NP—7900159, pp 33, Appendix 2:3) **INTRACOIN project, level 2: Interpretation of tracing experiments in porous and fractured media using the "METIS" code.** Goblet, P. (Ecole Nationale Superieure des Mines de Paris, France). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

The interpretation of a tracing experiment in porous medium by J.F. Pickens et al. [Water Research 17(3): 529-544 (1981)] is described. Both 1D and 2D analysis are presented. Two approaches for interpretation of the Finnsjoen test [KBS technical report 81-07 (1981)] in fractured medium are presented. (LM)

10968 (NP—7900159, pp 23, Appendix 2:4) **Summary report for INTRACOIN, level 2: Calculations for fractured medium case 2C using NAMRAD.** Hodgkinson, D.P.; Lever, D.A. (UK Atomic Energy Authority/Atomic Energy Research Establishment, Harwell). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

A model of tracer movement through a single fracture is presented and evaluated by numerical inversion of the analytical solution to the Laplace transformed equations. The model includes the effects of radial advection, hydrodynamic dispersion, kinetic surface sorption and diffusion into the rock matrix with equilibrium bulk sorption. It is used to analyze a field experiment on the transport of sorbed and non-sorbed tracers which forms part of level 2 of the International Nuclide Transport Code Intercomparison Study (INTRACOIN). The data is well fitted by the model and highlights the importance of rock matrix diffusion and kinetic sorption in such experiments.

10969 (NP—7900159, pp 14, Appendix 2:5) **Calculations for INTRACOIN, level 2: Fractured media, case C: Hydrodynamic dispersion-diffusion and stagnant water model.** Moreno, L.; Neretnieks, I. (Royal Institute of Technology, Stockholm, Sweden). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

Tracers were injected in one hole at a depth of about 100 m. In another hole 30 m distant water was continuously pumped up. In the studied run the sorbing tracer Sr was injected simultaneously with the nonsorbing tracer I. The experiments are reported by Gustafsson and Klockars (Report KBS TR 81-07). The evaluation of these tracer tests, using different models, is reported by Moreno et al. (Report KBS TR 83-38).

10970 (NP—7900159, pp 10, Appendix 2:6) **Calculations for INTRACOIN, level 2: Fractured media, case B: Hydrodynamic dispersion in several pathways model.** Moreno, L.; Neretnieks, I. (Royal Institute of Technology, Stockholm, Sweden). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

Tracers were injected in one hole at a depth of about 100 m. In another hole 30 m distant water was continuously pumped up. In the studied run the sorbing tracer Sr was injected simultaneously with the nonsorbing tracer I. It is assumed that the transport of the tracers from the point of injection to the point of pumping takes place through separate parallel fissures. There is no connection between the different pathways. The interaction between the tracer and the solid material is limited only to the walls of the fissures (surface sorption mechanism). For the iodide tracer test this model was tested using one, two and three pathways. The results are tabulated. When one pathway is simulated the fitting is poor. With two or three pathways the agreement with the experimental data is much better. No big difference between two and three pathways was found. The fit for the three-pathway model is presented graphically. In these calculations it is assumed that the Peclet number is equal in the different pathways. The calculated hydraulic properties for the three-pathway model are tabulated. The strontium tracer test was studied using the three-pathway model. The hydraulic properties determined by the iodide tracer test were used in this case. The surface sorption constant, K/sub a/, was included in the parameter determination. A loss factor was also included due to the low recovery of strontium. A value of 6.2×10^{-5} m was determined for the surface sorption coefficient on granite for the case of strontium. The loss factor which is a measure of some unknown and not modelled interaction must be included to get a fair fit. The loss factor was 0.4 for the strontium run.

10971 (NP—7900159, pp 13, Appendix 2:7) **Calculations for INTRACOIN, level 2: Fractured media, case C: Channeling dispersion-diffusion model.** Moreno, L.; Neretnieks, I. (Royal Institute of Technology, Stockholm, Sweden). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

Tracers were injected in one hole at a depth of about 100 m. In another hole 30 m distant water was continuously pumped up. In the studied run the sorbing tracer Sr was injected simultaneously with the nonsorbing tracer I. The dispersion that occurs in the direction of the flow is accounted for by means of channeling dispersion. The velocity differences in the channels will carry a tracer different distances over a given time. The transport of the tracers takes place through a fracture, in which parallel channels with different widths exist. It is assumed that the channel widths show a log-normal distribution and that the interconnection between the different channels is negligible. The hydrodynamic dispersion in each single channel is also assumed to be negligible compared to the effects of channeling. First, a fit is done for the nonorbing tracer, iodide, including the four parameters (σ, B, t/sub w/ and pf). The results show a B-parameter corresponding to a D/sub e/ value of 1.75×10^{-10} m²/s. This value does not agree with experimental measurements in the laboratory. If the B-parameter is calculated using the value of D/sub e/ determined in the laboratory (0.08×10^{-12} m²/s) and the fit is done for the other three parameters, the agreement is poor. The concentration at the top is constant and decreases rapidly to zero afterwards. The values for both cases are tabulated; and the corresponding curves are shown. For the sorbing tracer, strontium, the channeling dispersion, the water residence time and the dilution effect obtained from the iodide run are used. The other two parameters (K/sub a/ and B) are calculated by means of a fit. The results in this case give a value of about zero for the surface sorption equilibrium constant. For this reason the value of K/sub a/ experimentally determined in the laboratory is included and then the fit is only done for the B-parameter.

10972 (NP—7900159, pp 16, Appendix 2:8) **Calculations for INTRACOIN, level 2: Fractured media, case C: Hydrodynamic dispersion-diffusion model.** Moreno, L.; Neretnieks, I. (Royal Institute of Technology, Stockholm, Sweden). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

Tracers were injected in one hole at a depth of about 100 m. In another hole 30 m distant, water was continuously pumped up. In the studied run the sorbing tracer Sr was injected simultaneously with the nonsorbing tracer I. The model considers the transport of contaminants in a fluid that flows through a thin fracture situated in a water-saturated porous rock. The radial convergent flow in the experiment is modelled as linear flow. Sauty pointed out that this relationship is adequate when the Peclet number is 3. It is assumed that the transport of the tracers takes place through a single fissure. The tracers penetrate into the rock matrix by molecular diffusion and they may be adsorbed onto the fracture surface and within the rock matrix. The following processes are considered: advective transport along the fracture, longitudinal mechanical dispersion in the fracture, molecular diffusion from the fracture into the rock matrix, adsorption onto the surface of the fracture, and adsorption within the rock matrix.

10973 (NP—7900159, pp 30, Appendix 2:9) **TROUGH and INTRACOIN, level 2: Case 2A: Porous medium-idealised site.** Bazuin, P.; Hopkirk, R.J. (Polydynamics Ltd., Zuerich, Switzerland). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

INTRACOIN is the title of an international exercise in the comparison of radionuclide migration codes and models organized at the initiative of the Swedish Nuclear Power Inspectorate (SKI). The TROUGH-codes have been employed to solve some of the trial problems. The present report concerns the solution of a theoretical, two-dimensional problem posed in level 2 of INTRACOIN. Small variations in results have been obtained due to the use of alternative degrees of fineness of spatial discretization. More significant variations have resulted from the use of a full tensorial representation of the dispersion process.

10974 (NP—7900159, pp 29, Appendix 2:10) **Summary report for INTRACOIN, level 3: Calculations for the fracured medium case using NAM1D.** Hodgkinson, D.P.; Lever, D.A.; England, T.H. (UK Atomic Energy Authority/Atomic Energy Research Establishment, Harwell). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

A model for the transport of radionuclides through fractured rock has been developed and used to study a problem which forms part of level 3 of the international INTRACOIN project. The model includes the effects of one-dimensional advection, dispersion, kinetic and/or equilibrium surface sorption, diffusion into the rock matrix with equilibrium bulk sorption and radioactive decay, and incorporates flexible input and output boundary conditions. It is evaluated by numerically inverting the analytical solution to the Laplace transformed transport equations. Matrix diffusion was found to be the most important retardation mechanism for neptunium based on data reflecting the conditions at the Finnsjoe site in east central Sweden. However, improved data and field testing are required to make the predictions of such models more reliable.

10975 (NP—7900159, pp 30, Appendix 2:11) **Calculations for INTRACOIN, level 3: Fractured case.** Andersson, G.; Rasmuson, A.; Neretnieks, I. (Royal Institute of Technology, Stockholm, Sweden). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

The main object in this INTRACOIN level 3 study is to illustrate how the migration of radionuclides are influenced by various mechanisms. For this purpose twelve different cases are defined in which these mechanisms are varied. The cases treated in this report are tabulated. The reference given for each case indicates where the solution to the equations is to be found. Both analytical and numerical solutions have been utilized, and for some cases both are presented. (LM)

10976 (NP—7900159, pp 13, Appendix 2:12) **INTRACOIN study, level 3: Fractured medium: Results calculated by VTT, Finland.** Rasilainen, K.; Peltonen, E. (Technical Research Centre of Finland, Espoo). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

INTRACOIN study, level 3, fractured medium case was set up to investigate the impact of various physico-chemical mechanisms (dispersion, sorption, matrix diffusion and solubility limit) alone and together with each other on the discharge pulse. In this way it is possible to identify the mechanisms that have the strongest impact on the discharge pulse. 'Fractured medium' simulates conditions at the Finnsjoen site in east-central Sweden (depth 500 m, granitic rock). The bedrock is thought to consist of a regular grid of cubic blocks with flow porosity between the blocks. VTT has taken part in level 3 calculations using codes GETOUT and MMT1D.

10977 (NP—7900159, pp 3, Appendix 2:13) **Polydynamic using TROUGH at level 3.** Gilby, D.J. (Polydynamics Ltd., Zuerich, Switzerland). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

The INTRACOIN level 3 fractured medium problem has been calculated using the 1-D version of TROUGH. A central case and ten variants, incorporating alternative combinations of parameters, have been considered. The tenth variant includes non-equilibrium sorption as a mechanism and for this case three different values of the mass transfer rate constant k/sub s/ were used. Table 1 lists the cases calculated and the mechanisms included and Table 2 presents the results of these calculations, listing the maximum activity flux and the time at which this maximum occurs.

10978 (NP—7900159, pp 21, Appendix 2:14) **INTRACOIN, level 3: Fractured media case calculations.** Roesel, F.; Hadermann, J. (Swiss Federal Institute for Reactor Research, Wuerenlingen). [1986]. NTIS (US Sales Only), PC A14/MF A01. File Number DE87900159.

In INTRACOIN study: Appendices.

We have performed calculations for the central case and variation 1 to 9 defined in INTRACOIN level 3, fractured media case. On the one hand this is a benchmarking exercise yielding confidence in our numerical procedures by comparing results to those available from other project teams. On the other hand it shows the extreme impact of some physico-chemical processes on safety assessment taking parameters as defined in INTRACOIN level 3.

10979 (PNL—6047) **Chemical characterization, leach, and adsorption studies of solidified low-level wastes.** Walter, M.B.; Serne, R.J.; Jones, T.L.; McLaurine, S.B. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87004220.

Laboratory and field leaching experiments are beig conducted by Pacific Northwest Laboratory (PNL) to investigate the performance of solidified low-level nuclear waste in a typical, arid, near-surface disposal site. Under PNL's Special Waste Form Lysimeters-Arid Program, a field test facility was constructed to monitor the leaching of commercial solidified waste. Laboratory experiments were conducted to investigate the leaching and adsorption characteristics of the waste forms in contact with soil. Liquid radioactive wastes solidified in cement, vinyl ester-styrene, and bitumen were obtained from commercial boiling water and pressurized water reactors, and buried in a field leaching facility on the Hanford site in southeastern Washington State. Batch leaching, soil column adsorption, and soil/waste form column experiments were conducted in the laboratory, using small-scale cement waste forms and Hanford site ground water. The purpose of these experiments is to evaluate the ability of laboratory leaching tests to predict leaching under actual field conditions and to determine which mechanisms (i.e., diffusion, solubility, adsorption) actually control the concentration of radionuclides in the soil surrounding the waste form. Chemical and radionuclide analyses performed on samples collected from the field and laboratory experiments indicate strong adsorption of /sup 134,137/Cs and ^{85}Sr onto the Hanford site sediment. Small amounts of ^{60}Co are leached from the waste forms as

very mobile species. Some ^{60}Co migrated through the soil at the same rate as water. Chemical constituents present in the reactor waste streams also found at elevated levels in the field and laboratory leachates include sodium, sulfate, magnesium, and nitrate. Plausible solid phases that could be controlling some of the chemical and radionuclide concentrations in the leachate were identified using the MINTEQ geochemical computer code.

0540 Health And Safety

REFER ALSO TO CITATION(S) 10946

10980 **(GJ/TMC—24) Comparison of in-situ and laboratory measurement methods for radium-226 in soils.** Marutzky, S.J.; Fleischhauer, H.L.; Engelder, P.R.; Gilbert, R.O. (USDOE Grand Junction Projects Office, CO. Technical Measurements Center; UNC Technical Services, Inc., Grand Junction, CO (USA)). Oct 1986. Contract AC07-86ID12584. 165p. NTIS, PC A08/MF A01. File Number DE87004043.

Several methods are being used in the US Department of Energy remedial action programs (SFMP, UMTRAP, and FUSRAP) to determine ^{226}Ra concentrations in soils. These methods include in-situ measurements employing portable gamma-ray detection devices that measure the daughters of ^{226}Ra, and the laboratory analysis of physical samples. Both methods have their advantages and disadvantages. The in-situ measurements, although quick and relatively inexpensive, are affected by such things as environmental conditions and soil inhomogeneity, which make interpretation of the data difficult. These effects can be minimized by laboratory analysis of soil samples, but the process is slow and more expensive. Knowing these limitations, both methods can be useful in the remedial action programs. This study evaluates the equivalency of laboratory and in-situ methods by comparing means and regression relationships between one laboratory and five in-situ methods. The in-situ methods chosen for this study include spectrometer measurements using instruments manufactured by geoMetrics and Scintrex, and the so-called 'delta' measurement technique using instruments manufactured by Mount Sopris and Bendix Field Engineering Corporation. There are two objectives to the evaluation. The first objective evaluates the equivalency of mean concentrations, as observed with each of the six methods, in small (100 m^2), relatively homogeneous areas. The second objective evaluates the equivalency of the methods over a wide range of source strengths and inhomogeneous soil conditions. Results of the experiments conducted in this study indicate that the measurement methods do not give statistically equivalent estimates of ^{226}Ra concentration in soil. The in-situ devices tend to indicate higher concentrations of ^{226}Ra than the laboratory method.

10981 **(NAGRA-NTB—83-22) Dispersion of radionuclides in the biosphere: First compartment model examples.** Bundi, A. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1984. 48p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900397.

The dispersion of radionuclides in the biosphere and their uptake by man via various nutritional pathways is studied using a compartment model. The sample environment is the area of the lower Limmat and Aare valleys. General considerations of the compartmental description of the biosphere are made. The problem of the description of surface features, in particular soil, sediment and water, is studied in detail using the code BIOPATH. This study is intended to be an example of how a model of the biosphere could be constructed. It is shown that this is a reasonable model to calculate the spreading of radionuclides in the biosphere and that it indicates the relative significance of individual compartments, pathways and radionuclides. Calculated values of doses to man, however, should not be used as reference data for safety analyses.

10982 **(NUREG/CR—4658) Aerosols generated by spills of viscous solutions and slurries.** Ballinger, M.Y.; Hodgson, W.H. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Fuel Cycle and Material Safety). Dec 1986. Contract AC06-76RL01830. 30p. (PNL—5910). NTIS, PC A03/MF A01 - GPO. File Number TI87003990.

Safety assessments and environmental impact statements for nuclear fuel cycle facilities require an estimate of potential airborne releases caused by accidents. Aerosols generated by accidents are being investigated by Pacific Northwest Laboratory to develop methods for estimating source terms from these accidents. Experiments were run by spilling viscous solutions and slurries to determine the mass and particle-size distribution of the material made airborne. In all cases, 1 L of solution was spilled from a height of 3 m. Aqueous solutions of sucrose (0 to 56%) gave a range of viscosities from 1.3 to 46 cp. The percent of spill mass made airborne from the spills of these solutions ranged from 0.001 to 0.0001. The mass of particles made airborne decreased as solution viscosity increased. Slurry loading ranged from 25 to 51% total solids. The maximum source airborne (0.0046 wt %) occurred with the slurry that had the lightest loading of soluble solids. The viscosity of the carrying solution also had an impact on the source term from spilling slurries. The effect of surface tension on the source term was examined in two experiments. Surface tension was halved in these spills by adding a surfactant. The maximum weight percent airborne from these spills was 0.0045, compared to 0.003 for spills with twice the surface tension. The aerodynamic mass medium diameters for the aerosols produced by spills of the viscous solutions, slurries, and low surface tension liquids ranged from 0.6 to 8.4 μm, and the geometric standard deviation ranged from 3.8 to 28.0.

10983 **Radiation safety considerations for a test of deep geologic storage of spent nuclear fuel.** Straume, K.R.T. (Lawrence Livermore National Lab., P.O. Box 45, Mercury, NV). *Nuclear Science and Engineering;* **94**: No. 3, 282-286(Nov 1986). Contract W-7405-ENG-48.

As part of the Nevada Nuclear Waste Storage Investigations, the Lawrence Livermore National Laboratory conducted a test for the U.S. Department of Energy to evaluate both the feasibility of deep geologic storage and the safety of handling spent nuclear fuel assemblies. The radiological monitoring and dosimetry program instituted for the Spent Fuel Test-Climax is discussed. During the 3-yr storage phase of the test, no measurable radioactive effluent was released. Radiation exposures to personnel handling the shielded spent fuel assemblies ($\approx$500 Gy/h at contact when unshielded) were $<$4 person-mSv for the duration of the project.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 11778

10984 **(LA—10045-Rev.) The use of calibration standards and the correction for sample self-attenuation in gamma-ray nondestructive assay.** Parker, J.L. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003810.

The efficient use of appropriate calibration standards and the correction for the attenuation of the gamma rays within an assay sample by the sample itself are two important and closely related subjects in gamma-ray nondestructive assay. Much research relating to those subjects has been done in the Nuclear Safeguards Research and Development program at the Los Alamos National Laboratory since 1970. This report brings together most of the significant results of that research. Also discussed are the nature of appropriate calibration standards and the necessary conditions on the composition, size, and shape of the samples to allow accurate assays. Procedures for determining the correction for the sample self-attenuation are described at length including both general principles and several specific useful cases. The most useful concept is that knowing the linear attenuation coefficient of the sample (which can usually be determined) and the size and shape of the sample and its position relative to the detector permits the computation of the correction factor for the self-attenuation. A major objective of the report is to

explain how the procedures for determining the self-attenuation correction factor can be applied so that calibration standards can be entirely appropriate without being particularly similar, either physically or chemically, to the items to be assayed. This permits minimization of the number of standards required to assay items with a wide range of size, shape, and chemical composition.

10985 **(LA—10842-MS) Calculation of fast-neutron induced-fission multiplication in large PuO_2 samples.** Menlove, H.O.; Rinard, P.M. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003808.

Fast-neutron multiplication in large PuO_2 samples has been studied using both Monte Carlo computer codes and the coincidence correlation equations developed by K. Boehnel and N. Ensslin. Samples covering the mass range from 0.1 to 7.2 kg of plutonium have been measured and the multiplication results were compared with the theoretical predictions. The results are in agreement within the uncertainties in the sample characteristics. A parametric study was performed to determine the effect of sample density and moisture variation on the neutron multiplication.

10986 **(UNI-SA—183) Insider protection at N area.** Debban, H.L. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 17 Sep 1986. Contract AC06-76RL01857. 9p. (CONF-8610182—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002690.

From Annual symposium on safeguards of nuclear material; Richland, WA, USA (14 Oct 1986).

This paper describes the method which was used to develop solutions to the insider security problem at Hanford's N-reactor area.

10987 **Optimal allocation of safeguards inspection resources for a nuclear fuel cycle.** Fishbone, L.G. (Brookhaven National Lab., Upton, NY). *Nuclear Materials Management;* **14**: No. 2, 22-36(1986). Contract AC02-76CH00016.

In planning its safeguards inspections at peaceful nuclear facilities, the International Atomic Energy Agency must deploy its limited inspection resources according to some allocation procedure. In this paper the author demonstrates a technique for optimally allocating such resources within a hypothetical nuclear fuel cycle.

0560 Legislation And Regulations

10988 **(NUREG—1241) Licensing of alternative methods of disposal of low-level radioactive waste: Branch technical position, Low-Level Waste Licensing Branch.** Higginbotham, L.B.; Dragonette, K.S.; Pittiglio, C.L. Jr. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Dec 1986. 29p. NTIS, PC A03/MF A01 - GPO. File Number TI87900412.

This branch technical position statement identifies and describes specific methods of disposal currently being considered as alternatives to shallow land burial, provides general guidance on these methods of disposal, and recommends procedures that will improve and simplify the licensing process. The statement provides answers to certain questions that have arisen regarding the applicability of 10 CFR 61 to near-surface disposal of waste, using methods that incorporate engineered barriers or structures, and other alternatives to conventional shallow land burial disposal practices. This position also identifies a recently published NRC contractor report that addresses the applicability of 10 CFR 61 to a range of generic disposal concepts and which provides technical guidance that the staff intends to use for these concepts. This position statement combined with the above-mentioned NRC contractor report fulfills the requirements of Section 8(a) of Public Law 99-240, the Low-Level Radioactive Waste Policy Amendments Act of 1985.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

10989 (CONF-851268—, pp 20-25) **Use of radioisotopes (1-92) made at a steady state neutron facility.** Yelon, W.B.; Ehrhardt, G.J.; Brugger, R.M. 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The use of reactor-produced radioisotopes is reviewed, with emphasis on those applications which require high neutron fluxes. Considerable opportunities are noted for new or improved utilization if neutron fluxes in the $10^{20}/m^2$ s range can be achieved. New uses are seen in medical applications, condensed matter research and in a variety of industrial applications.

0703 Isotopic Power Supplies

10990 **(LA—10697-MS) Explosion overpressure test series: General-Purpose Heat Source development: Safety Verification Test program.** Cull, T.A.; George, T.G.; Pavone, D. (Los Alamos National Lab., NM (USA)). Sep 1986. Contract W-7405-ENG-36. 77p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87002997.

The General-Purpose Heat Source (GPHS) is a modular, radioisotope heat source that will be used in radioisotope thermoelectric generators (RTGs) to supply electric power for space missions. The first two uses will be the NASA Galileo and the ESA Ulysses missions. The RTG for these missions will contain 18 GPHS modules, each of which contains four $^{238}PuO_2$-fueled clads and generates 250 W/sub (t)/. A series of Safety Verification Tests (SVTs) was conducted to assess the ability of the GPHS modules to contain the plutonia in accident environments. Because a launch pad or postlaunch explosion of the Space Transportation System vehicle (space shuttle) is a conceivable accident, the SVT plan included a series of tests that simulated the overpressure exposure the RTG and GPHS modules could experience in such an event. Results of these tests, in which we used depleted UO_2 as a fuel simulant, suggest that exposure to overpressures as high as 15.2 MPa (2200 psi), without subsequent impact, does not result in a release of fuel.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 11853

10991 **A hybrid quantum/thermal solar energy system for hydrogen production.** Schell, D.; Karpuk, M.; West, R. (Solar Energy Research Institute, Golden, CO 80401). pp 360-363 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—).

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

A systems analysis of a hybrid quantum/thermal central receiver solar system has been performed to assess the possibility of producing hydrogen at a lower cost than from a thermal-only system acting alone. The cost of producing hydrogen by electrolysis is compared to the cost of producing hydrogen by the hybrid system. The hybrid system uses a beam splitter to separate the solar spectrum into short- and long-wavelength components for use by separate quantum and thermal receivers respectively. The thermal side of the plant utilizes the same conversion process as the thermal-only plant, while the quantum receiver uses a photoelectrochemical process for the direct conversion of sunlight into hydrogen. Details on the quantum receiver design and the photoelectrochemical process are discussed. The cost of hydrogen produced from the hybrid system (26/G3) is 13% lowe than from the thermal-only

plant ($30/G3), with optimistic assumptions regarding the operation of the photoelectrochemical process and today's cost of solar central receiver systems. When more technically realizable assumptions are made there appears to be no advantage to choosing the hybrid system at this time.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 10701, 10717, 10720, 10881, 11553, 11864

10992 **(AD-A—172496/2/XAB) Economic feasibility study on the space-based production of methane gas from human waste through aerobic digestion for use as an orbit-maintenance propellant. Master's thesis.** Fallstead, C.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1985. 149p. (AFIT/GSO/ENS—85D-8). NTIS, PC A07/MF A01.

This project explores the economic feasibility of creating fuel energy in space from human waste with application toward space-station orbit maintenance. The energy-generating concept proposed in this study is anaerobic digestion. This process has four benefits for space application; 1) it can stabilize human waste products, 2) it can reduce solid wastes, 3) it can provide a fairly clear effluent for water recovery, and 4) it can provide a fuel in the form of a gas. The analysis is dependent upon a predetermined scenario defining the input load to the digester system and the size of the spacecraft. The size, shape, and altitude of the vehicle determine the atmospheric drag that must be opposed to maintain the orbit. The basic elements of the study involve 1) simulation analysis of biochemistry, 2) thermochemical analysis and, 3) cost analysis using the Monte Carlo method. An alternative system to which the digester is compared is transport of conventional propellants from Earth. This alternative does not consider a replacement of the anaerobic digester with some other system to stabilize the waste products of the space station, or the additional benefits of the anaerobic digester listed above. The results of this study show a statistically significant advantage of the digester system over transported conventional propellants due to the high cost of space transportation.

10993 **(DOE/CS/40202—T19-Vol.1) Conversion of cellulosic wastes to liquid hydrocarbon fuels: Vol. 1, Project overview: Final report.** Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Nov 1986. Contract AC02-76CS40202. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003646.

An indirect liquefaction approach is used, i.e., gasification to synthesis gas followed by liquefaction of the synthesis gas. The primary virtue of an indirect liquefaction approach for cellulosic type feedstocks is that oxygen contained in the materials is easily separated. Thus the hydrocarbon liquid product is free of oxygenated compounds and can therefore be tailored to match transportation fuel products currently derived from petroleum. Approximately 100 biomass materials were studied as received from private industry, government laboratories and other university laboratories. The feedstock candidates included industrial wastes, agricultural and forest residues and crops that would be deliberately grown for energy conversion purposes. The product of the process is a liquid hydrocarbon transportation grade fuel similar to diesel. This can be upgraded to high octane gasoline via catalytic reforming if desired. The products should be compatible with existing engine designs and fuel distribution and marketing systems. The major virtue of the process is that a renewable, often low valued material is used as the feedstock to produce a quality product.

10994 **(DOE/CS/40202—T19-Vol.2) Conversion of cellulosic wastes to liquid hydrocarbon fuels: Vol. 2, A kinetic study of the modified Fischer-Tropsch synthesis over an alumina-supported cobalt oxide catalyst: Final report.** Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Nov 1986. Contract AC02-76CS40202. 505p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE87003647.

A modified Fischer-Tropsch reaction with the incorporation of ethylene in the synthesis gas has been studied kinetically. The feed mixture was also comprised of methane and carbon dioxide in a proportion similar to a real pyrolysis gas composition. The feed gas was provided by a manifold of compressed gas cylinders. An alumina-supported cobalt oxide catalyst was prepared by an impregnation method and used in the experimentation.

10995 **(DOE/CS/40202—T19-Vol.3) Conversion of cellulosic wastes to liquid hydrocarbon fuels: Vol. 3, Supervisory control system development for an indirect liquefaction process: Final report.** Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Nov 1986. Contract AC02-76CS40202. 481p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE87003648.

A supervisory process control system for the Biomass Indirect Liquefaction Pilot Plant has been developed. A microcomputer, the IBM 9000 system, was utilized for data acquisition, reduction, and adjustment, process modeling, simulation, and off/on-line optimization. The IBM 9000 is interfaced with the process through a front end data acquisition system.

10996 **(DOE/CS/40202—T19-Vol.4) Conversion of cellulosic wastes to liquid hydrocarbon fuels: Vol. 4, Slurry phase synthesis of liquid hydrocarbon fuels from biomass pyrolysis gas using iron catalysts: Final report.** Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Nov 1986. Contract AC02-76CS40202. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87003649.

An experimental assessment of liquids and iron based catalysts for use in a Fischer-Tropsch slurry reactor has been conducted. The best catalyst/liquid combination was found to be a 48Fe/4.8Cu/47.2Kieselguhr catalyst in Chevron Refined Wax 143. At the optimum operating conditions of 300°C, 200 psig, using a 5 weight % catalyst slurry with a molar H_2/CO feed ratio of 0.5, the yield of product was 118 mg/g-cat/h. Five different catalysts were tested in their ability to produce diesel type fuels from biomass pyrolysis gas. The catalysts tested, in order of decreasing product yield, were: kieselguhr supported, potassium promoted alumina supported, potassium promoted unsupported, unsupported, and alumina supported iron. A two-level factorial study using temperature, pressure, H_2/CO feed ratio, and catalyst concentration in the slurry as factors was also performed.

10997 **(DOE/CS/40202—T19-Vol.5) Conversion of cellulosic wastes to liquid hydrocarbon fuels: Vol. 5, Microwave heating of fluidized bed reactors: Pyrolysis and calcination applications: Final report.** Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Nov 1986. Contract AC02-76CS40202. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003650.

A microwave system was designed and built that was capable of reliably and efficiently heating a fluidized bed reactor to elevated temperatures. System applications included pyrolyzing euphorbia lathyris feedstock at 1450°F and calcining 10% cobalt/alumina catalyst at 900°F.

10998 **(DOE/CS/40202—T19-Vol.6) Conversion of cellulosic wastes to liquid hydrocarbon fuels: Vol. 6, The modeling and design of a staged indirect liquefaction reactor: Final report.** Kuester, J.L. (Arizona State Univ., Tempe (USA). Coll. of Engineering and Applied Sciences). Nov 1986. Contract AC02-76CS40202. 229p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003651.

A staged reactor was designed to convert biomass to useful fuels. The reactor consists of three stages. The first stage is a concentric combustor/pyrolyzer system where the biomass is gasified in a fluidized bed at high temperatures in the absence of oxygen. The second stage is a cyclonic scrubber where particulates and condensable materials are removed from the gas stream while the gas is cooled. In the final stage the gas undergoes a Fischer-Tropsch synthesis in a fluidized bed or slurry reactor. Mathematical models of the system were developed and used to create computer programs that would predict the behavior of the bed. The models

were based on fundamental phenomena and were used to predict key dimensions of the staged reactor system. A transparent plastic, full-scale, cold flow reactor simulator was built using the models' predictions. The simulator was used to refine the models and determine the operating characteristics of the reactor. The design was determined to be workable and potentially useful. The reactor was, however, difficult to operate and would require extensive automated control systems.

10999 **(DOE/SF/12221—T6) Photolytic enhancement studies: Monthly technical progress report, 04/01/86-04/30/86.** (Hawaii Univ., Honolulu (USA)). 30 Apr 1986. Contract AC03-84SF12221. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003188.

Quantitative results are presented of the experiments performed to study the cracking of propene photosensitized by acetone. In an experiment conducted at 300°C with a residence time of 45s and a molar acetone concentration of 20%, a 2% conversion of propene was observed. The product yields were: 54% butane, 34% butene, 24% ethane, 14% ethene, 8% hexene and unquantified amounts of propane and C_7 hydrocarbons. To study the effect of temperature and the amount of free radicals generated on the pyrolysis chemistry of propene, another experiment was conducted at 200°C with 5% molar concentration of acetone and a residence time of 16s. The conversion was found to be 0.5% with the following product yields: 25% ethene, 17% hexene, 11% butane, 9% ethane, 8% butene and unquantified amounts of C_7 hydrocarbons. From these results, it is clear that methyl radicals add on to free radical scavenger propene yielding a number of higher alkenes and alkanes. The temperature and amount of acetone serve to enhance the effect of addition of photolytically generated methyl radicals to propene. 3 tabs.

11000 **(ENEA-RT/FARE—85/9) Experimental test of a biomass gasification prototype.** Brunetti, N.; de Simone, L.; Menichilli, U. (ENEA, Casaccia (Italy). Dipartimento Fonti Alternative e Risparmio Energetico). Oct 1985. 65p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87900401.

Combustible gas known as producer gas can be obtained by partial combustion of solid fuels. The performance of several producer gas systems have been investigated. Experiments were carried out on both fixed and fluid bed gasifiers to examine the specific fuel consumption at various values of output power from the generator, the temperature in different sides of the gasifiers, the quality of the gas in relation to the solid fuels used. The technical feasibility of producer gas in electricity generation and some practical aspects concerning the performance and operation of the systems and the quality of the gas produced are considered. 9 figs., 8 tabs.

11001 **(EPRI-AP—4834) Biologic coal beneficiation: Literature review: Final report.** Pyne, J.W.; Wilson, B.W. (Pacific Northwest Lab., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87004105.

Several approaches to the biological beneficiation of coal have been suggested in the literature. The chemical similarity between coal, especially low-rank coal, and lignin suggest that lignin-degrading microorganisms, particularly white-rot fungi, could degrade coal by oxygen-requiring reactions. There are some indications that these processes can occur. Solubilization of coal by the action of white-rot fungi, such as Polyporus vesicolor has been reported. Bacterium such as Pseudomonas fluorescence appear capable of biodegrading coals including higher rank materials such as anthracite. Besides degrading coal, this bacterium was shown to produce extracellular protein that adsorbed to the surface of the coal particles. The adsorbed protein significantly reduced the surface tension of the coal, suggesting a potential role of this protein as a surfactant in coal slurrying. In coals containing finely dispersed pyrite, pyritic sulfur and, to a degree, organic sulfur can be removed by Thiobacillus ferrooxidans or Sulfolobus acidocaldarius, which oxidizes sulfur for energy production. Based on laboratory data, the biological, coal-desulfurization process appears to be cost-effective when compared to other chemical-desulfurization methods. This review reveals the general absence of data on coal degradation, enzyme production and characterization, and effects of coal substrate, nutritional requirements, on degradation rates. Screening of additional organisms for coal degrading activity or isolation and evaluation of cell-free-enzyme extracts as bioreagents for coal conversion appear to be areas which may be fruitful in the near term. Each of these issues must be addressed if progress in this new area of biotechnology is to continue. 76 refs., 10 figs., 3 tabs.

11002 **(PNL—5844) Catalytic hydrotreating of biomass liquefaction products to produce hydrocarbon fuels: Interim report.** Elliott, D.C.; Baker, E.G. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87004217.

Research catalytic hydrotreatment of biomass liquefaction products to a gasoline has been technically demonstrated in a bench-scale continuous processing unit. This report describes the development of the chemistry needed for hydrotreatment of both high pressure and pyrolyzate biomass liquefaction products and outlines the important processing knowledge gained by the research. Catalyst identity is important in hydrotreatment of phenolics. Hydrogenation catalysts such as palladium, copper chromite, cobalt and nickel show activity with nickel being the most active. Major products include benzene, cyclohexane, and cyclohexanone. The hydrotreating catalysts cobalt-molybdenum, nickel-molybdenum and nickel-tungsten exhibit some activity when added to the reactor in the oxide form and show a great specificity for hydrodeoxygenation of phenol without saturation of the benzene product. The sulfide form of these catalysts is much more active than the oxide form and, in the case of the cobalt-molybdenum, much of the specificity for hydrodeoxygenation is retained. Substitution on the phenolic ring has only marginal effects on the hydrotreating reaction. However, the methoxy (OCH_3) substituent on the phenol ring is thermally unstable relative to other phenolics tested. The pyrolysis products dominate the product distribution when cobalt-molybdenum is used as the hydrotreating catalyst for methoxyphenol. The product from catalytic hydrotreatment of high-pressure biomass liquefaction products confirms the model compounds studies. Catalytic processing at 350 to 400°C and 2000 psig with the sulfided cobalt-molybdenum or nickel-molybdenum catalyst produced a gasoline-like product composed of cyclic and aromatic compounds. Oxygen contents in products were in the range of 0 to 0.7 wt % and hydrogen to carbon atomic ratios ranged from 1.5 to 2.0. 46 refs., 10 figs., 21 tabs.

11003 **Hydrodeoxygenation of wood-derived liquids to produce hydrocarbon fluids.** Elliott, D.C.; Baker, E.G. (Pacific Northwest Lab., Richland, WA). *Society of Automotive Engineers Technical Paper Series;* No. 859096, 1.586-1.592(1985). Contract AC06-76RL01830.

From 20. Intersociety energy conversion engineering conference; Miami Beach, FL, USA (18-23 Aug 1985).

Catalytic hydrotreating of wood-derived liquids is being studied at Pacific Northwest Laboratory. Using a continuous-feed, fixed-bed reactor, commercial hydrotreating catalysts and conditions are used to hydrodeoxygenate and hydrocrack the products of biomass liquefaction. Experiments are performed in an upflow reactor wherein both liquid phase and gas phase reactions are considered to be important. Although hydrocarbons are not produced in any significant amount by thermochemical direct liquefaction of wood, the use of secondary hydrogenation step to treat the initial product can result in nearly pure hydrocarbons. These hydrocarbons are primarily cyclics and aromatics which would be useful in gasoline blending. Experimental results with either cobalt/molybdenum or nickel/molybdenum catalyst show that deoxygenation of the primarily phenolic wood oil is achieved in either case. The extent of saturation of the liquid product is dependent on catalyst type, operating temperature and relative flows of oil feedstock and hydrogen gas. 23 references, 1 figure, 5 tables.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 10719, 10722, 11055

11004 **(AD-A—172730/4/XAB) Detailed chemical analysis of fuel methanol for trace impurities. Interim report, January-August 1986.** Present, D.L.; Kohl, K.B. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Sep 1986. 30p. (BFLRF—216). NTIS, PC A03/MF A01.

Two samples of methanol, one a coal-derived product and the other a natural gas-derived product, were obtained for analysis. The coal-derived methanol was received in a 5-gallon steel can and the natural gas-derived methanol was received in 1-gallon glass bottles. The detailed analysis reported in this interim report provides an initial assessment of the compositional differences between the two methanols produced from different raw materials.

11005 **(DOE/ER/13512—1) The mechanism of switching from an acidogenic to butanol-acetone fermentation by Clostridium acetobutylicum: Technical progress report, April 1986-December 1986.** Rogers, P. (Minnesota Univ., St. Paul (USA)). 1986. Contract FG02-86ER13512. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003690.

This research seeks to illucidate the molecular mechanisms used by the obligate anaerobe, Clostridium acetobutylicum to regulate the synthesis and activity of the key enzymes catalyzing reactions in this organism's fermentation pathway. Report is hereby made on the isolation and characterization of regulatory mutants, development of DNA transformation of protoplasts, and the analysis of aldehyde dehydrogenase, phosphotransbutyrylase and butyrate kinase. 4 refs., 1 tab.

11006 **(DOE/ID/12188—T2-Vol.1) South Point Ethanol 60-million gallon per year fuel-ethanol plant: Final report.** Hill, L.; Hicks, H.; Hopkins, W.; Jordan, B.; Andersen, R. (South Point Ethanol, OH (USA)). Sep 1986. Contract FC07-81ID12188. 232p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003493.

This report describes the design, construction, and operation of a 63-million gallon per year fuel-ethanol plant built by South Point Ethanol on a 600-acre site of a decommissioned ammonia fertilizer facility in South Point, Ohio. The existing coal-fired boiler complex, rail system, utilities, large and small tanks, distillation columns, and other equipment, and several process and office buildings were refurbished and used as part of the ethanol facility. The process design was performed by Raphael Katzen Associates based on dry milling of corn, batch fermentation, distillation to anhydrous ethanol, mechanical vapor recompression of the thin stillage, and steam tube drying of the distillers dried grain with solubles. Pritchard Corporation was the primary subcontrator for both the engineering and construction. The plant production and operational history from startup in September 1982 through June 1986 is presented along with a discussion of all the plant modifications, operating costs, and maintenance requirements. The plant operating performance is compared to the original design criteria and the original project economics are compared with the actual plant profitability.

11007 **(DOE/ID/12188—T2-Vol.2) South Point Ethanol 60-million gallon per year fuel-ethanol plant: Final report.** Hill, L.; Hicks, H.; Hopkins, W.; Jordan, B.; Andersen, R. (South Point Ethanol, OH (USA)). Sep 1986. Contract FC07-81ID12188. 194p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003494.

Three appendices are included: computerized materials balances; critical equipment; and as-built drawings. (DLC)

11008 **(DOE/PC/80013—T3) Indirect liquefaction of coal via biosynthesis.** (Bechtel National, Inc., San Francisco, CA (USA)). Oct 1986. Contract AC22-85PC80013. 105p. NTIS, PC AO6/MF A01; 1; GPO Dep. File Number DE87002324.

The work reported here examines the concept of using microorganisms as a highly selective biocatalyst for the syngas conversion. Since a suitable organism has not been identified, the work attempts to define the desirable properties of the biocatalyst, indicates the possible incentive for its development, and suggests a plan for continued development of the concept. A single overall concept was evaluated in which an alcohol is produced by the bioconversion from a cooled and partially purified syngas. The alcohol is recovered from the organism suspension by evaporation and prepared for use as a gasoline blending component by conventional concentration and drying. Three design cases were developed for economic evaluation: (1) ethanol production assuming a single-stage bioconversion; (2) n-butanol production in a single-stage bioconversion; and (3) ethanol production based on a two-stage bioconversion in which an acetate solution is produced in the first stage and then converted to the final ethanol product in a second bioconversion. The overall process scheme, together with the scale of production, is illustrated in Figure 1-1. All costs presented reflect first-quarter 1986 US dollar estimates. 10 refs., 20 figs., 24 tabs.

11009 **(EUR—9185) New methods of alcohol production (carbons and hydrocarbon-based compounds) from synthesis gas.** Teyssie, P.; Drapier, J.; Noels, A.F.; Hubert, A.J. (Commission of the European Communities, Luxembourg). 1984. 85p. (In French and English). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

The direct production of oxygenated products, particularly alcohols by CO hydrogenation is of major industrial interest. Owing to the high cost of rhodium based catalysts, the present work reports on the relevance of cobalt catalysis. Reduced cobalt species (Co(I)COD) appeared to be active for CO hydrogenation under a wide range of pressures (from 1 up to 500 bars). Olefin rich hydrocarbon mixtures (CH_4 being the main component) were obtained under low pressure (1 bar) conditions to recycling syngas and trapping products. Conversely, small amounts of alcohols were detected when reduction was effected in autoclaves under high pressure (150 bars). The reaction appeared very sensitive to factors such as temperature, the use of a support and pressure. Selectivity in alcohols (relatively) to other oxygenates) was generally good but remained very low relatively to alkanes production (5-16%). Moreover, the catalyst was readily deactivated (except under low pressure conditions with recycling of gases and trapping of products which probably participate in the deactivation of the catalyst). Results indicate that alcohol production seems to be limited to very few catalytic cycles and the stabilization of the alcohol-producing catalyst centers has not been achieved. An investigation of bimetallic systems (Co-Rh) was also approached, decreasing the amounts of rhodium catalysts while preserving catalytic activity. However, the expensive rhodium based catalysts remain the best systems for ethanol production. The use of polymetallic systems on different (basic) oxides remains a valuable research approach to the design of a selective and cheap catalyst for direct ethanol production from syngas.

11010 **(PB—87-106985/XAB) Effect of different crop species and mixtures and storage methods on ethanol production. Final report, 19 July 1985-31 July 1986.** Finkner, R.E.; Houck, W.S. (New Mexico State Univ., Clovis (USA). Agricultural Science Center). Aug 1986. 61p. NTIS, PC A04/MF A01.

Different feedstocks -- corn, grain sorghum, wheat and barley were tested for ethanol production as pure species and in mixtures. Some compensatory responses were discovered such as foam reduction in barley feedstocks. Cull potatoes were also tested for ethanol production in their pure state and in combination with grain sorghum. Potato producers could derive additional income if cull potatoes could be profitably used in the production of ethanol. A potato and grain mixture may alleviate the necessity of adding additional grinding equipment to process fleshy high-moisture material. It is noteworthy to point out that the hammer mill employed at NMSU Agricultural Science Center at Clovis has no problems in processing potatoes in their pure form. Ensiling storage for high-moisture corn and sweet sorghum was tested to determine the effect on ethanol production. High-moisture corn proved to be an acceptable feedstock for ethanol production. Because of significant deterioration of the ensiled sweet sorghum samples, further investigation into appropriate techniques to simulate silage on a small-scale is needed.

11011 (TVA/OACD—86/10) Integrated fuel alcohol production systems: Phase 3, Second annual Experimental Facility testing report for the period January 15, 1985-January 15, 1986. Barrier, J.W.; Farina, G.E.; Lightsey, G.R.; Broder, J.D.; Forsythe, M.L.; Moore, M.R.; Lambert, R.O. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). Feb 1986. Contract AI01-80CS80010. 103p. NTIS, PC A06/MF A01. File Number DE87003785.

The Tennessee Valley Authority and the US Department of Energy are cooperating in a program to produce ethanol. This phase of the research and developmet program consists of the development of technology to produce ethanol from agricultural residues and forage crops, using a low-temperature, low-pressure, concentrated acid hydrolysis process. The acid hydrolysis experimental facility, completed in April 1984, was built to evaluate acid hydrolysis process technology and is connected to the fermentation and distillation unit. Tests conducted in the facility were designed to scaleup laboratory results, define optimum operating conditions to yield the highest hemicellulose and cellulose conversion efficiencies, determine better material handling systems, verify long-term acceptability of fiberglass reinforced plastics used in the piping systems and vessels, verify safe operating procedures, and determine sugar storage conditions for minimal degradation. This report describes the tests conducted during 1985. Improvements such as single step acid hydrolysis and acid recovery techniques were also investigated, and the results are discussed. Process schemes designed to treat, dispose, or use effluent streams associated with the acid hydrolysis process are also described. The experimental plant was operated in March and June 1985. Verification of the conversion efficiencies for hemicellulose-to-pentose and cellulose-to-hexose sugars observed during the November 1984 test was the primary goal for both plant trials. Other objectives were the evaluation of the vacuum dryer hot oil unit, evaluation of modifications to the hemicellulose reactor, optimization of the hemicellulose reaction leaching sequence, optimization of the cellulose pretreatment and reactor step without the prehydrolysis soaking step, verification of safe operating procedures, and assessment of materials of construction. 23 refs., 17 figs., 14 tabs.

11012 (TVA/PUB—87/4) Effective pretreatment alternatives for the production of ethanol from hemicellulosic hardwood hydrolyzates. Strickland, R.C.; Beck, M.J. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Chemical Development). 1985. 24p. (CONF-850104—10). NTIS, PC A02/MF A01. File Number DE87900336.

From 9. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (28 Jan 1985).

Pretreatment and nutrient additions are required for reliable and acceptable ethanol production from acid-catalyzed hemicellulosic hardwood hydrolyzates by the yeast Pachysolen tannophilus. Neutralization of heated hydrolyzate, sulfite additions, and overliming [raising the pH to 10 with $Ca(OH)_2$ and then lowering the pH for conversion] alone and in various combinations were evaluated for desirable effects on ethanol production. Individual pretreatments were not as effective as pretreatment combinations. Overliming of heated hydrolyzate with the addition of sulfite was the most effective pretreatment combination, but other combinations were nearly as good. Sufficient sulfite can substitute for either heat or overliming. Both heat and overliming reduce the amount of sulfite required as a pretreatment. Excess sulfite results in the inhibition of ethanol production. The choice of a pretreatment scheme will depend on the overall process design and the consideration of pretreatment costs in relation to improved yield. Sulfite treatment was effective at different stages of overliming and sulfuric acid was suitable for pH adjustment. The reason for pretreatment improvement of conversion requires further study. Besides hydrolyzate pretreatment, nutrient additions are also important for ethanol production. Yeast extract, urea, and phosphate had tentatively been identified as useful nutrient supplements. While P. tannophilus has a phosphate requirement in hydrolyzate, yeast extract and urea may be adequate nutrient additions because sufficient phosphate but insufficient nitrogen are supplied from the yeast extract. Conversion was reduced without nutrient additions or with either urea of phosphate alone. Varying the concentration of yeast extract at a fixed level of urea and phosphate reduced ethanol production at high levels of yeast extract, perhaps because of nutrient imbalances. 16 refs., 7 figs.

11013 Liquid-phase methanol process promises cost saving. Haggin, J. *Chemical and Engineering News;* No. 1707, 21-22(4 Aug 1986).

A group at Brookhaven National Laboratory (BNL) is developing a liquid-phase process for synthesis of methanol from natural gas. Independent cost estimates for a plant using the new process are considerably lower than those for a corresponding plant based on present technology. The group at Brookhaven believes it has overcome most of the objections to steam reforming and the high capital investment in partial oxidation processes. The key factor is a new methanol synthesis catalyst. The researchers declined to identify the catalyst other than to say that it is a liquid solution that provides synthesis gas conversion of more than 90%, is active at low temperatures (around the normal boiling point of water), and permits removal of heat to be decoupled from the process kinetics. The new BNL catalyst, which is being developed with funding from the Department of Energy, makes it possible to take advantage of the unique natural gas requirements for partial oxidation because the high conversion rates eliminate the need for recycle. That permits the use of air and eliminates concerns about inert gas buildup. Atmospheric nitrogen, in the oxidation air, leaves the process at elevated pressure and can be expanded to extract compressor power. What that suggests to the BNL group is the possibility of being able to use methanol, rather than LNG, to transport natural gas energy to the marketplace.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 10830, 10831, 11048, 11054, 11092, 11174

11014 (SERI/SP—271-2839) Thermodynamic data for biomass conversion and waste incineration. Domalski, E.S.; Jobe, T.L. Jr.; Milne, T.A. (National Bureau of Standards, Washington, DC (USA); Solar Energy Research Inst., Golden, CO (USA)). Sep 1986. Contract AC02-83CH10093. 339p. NTIS, PC A15/MF A01; GPO Dep. File Number DE86014515.

The general purpose of this collection of thermodynamic data of selected materials is to make property information available to the engineering community on chemical mixtures, polymers, composite materials, solid wastes, biomass, and materials not easily identifiable by a single stoichiometric formula. More than 700 materials have been compiled covering properties such as specific heat, gross heat of combustion, heat of fusion, heat of vaporization, and vapor pressure. The information was obtained from the master files of the NBS Chemical Thermodynamics Data Center, the annual issues of the Bulletin of Chemical Thermodynamics, intermittent examinations of the Chemical Abstracts subject indexes, individual articles by various authors, and other general reference sources. The compilation is organized into several broad categories; materials are listed alphabetically within each category. For each material, the physical state, information as to the composition or character of the material, the kind of thermodynamic property reported, the specific property values for the material, and citations to the reference list are given. In addition, appendix A gives an empirical formula that allows heats of combustion of carbonaceous materials to be predicted with surprising accuracy when the elemental composition is known. A spread sheet illustrates this predictability with examples from this report and elsewhere. Appendix B lists some reports containing heats of combustion not included in this publication. Appendix C contains symbols, units, conversion factors, and atomic weights used in evaluating and compiling the thermodynamic data.

11015 (STEV-SB—86-22) Storage of bundled unlimed pulpwood and logging residues. Thoernqvist, T.; Flinkman, M. (Statens Energiverk, Stockholm (Sweden)). Jul 1986. 66p. (In Swedish and English). (SLU-IVL—180). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750632.

The present work aims at illustrating the storage properties of bundles consisting of unlimbed pulpwood, logging residues and bundle-delimbed material. The bundling is done using the Method Slyman mobile machine. The bundles were placed in a stack of about 100/sp/3. Samples were taken for determinations of moisture content, composition,basic density, ash content, heating value, hydrogen content and the number of microfungi. The composition of

components in unlimbed pulpwood at the start of the storage consisted of 70-80% wood, 1-2% needles/leaves, 14-18% bark, 2-10% of small branches and about 1% of fines. The corresponding distribution in fresh logging residues was 45% wood, 21% bark, 24% needles, 7% small branches and 3% fines. For unlimbed pulpwood of pine, spruce and birch the respective weighed mean basic densities were about 380 kg/msp3, 400 kg/msp3 and 450 kg/msp3. Values for fresh and old logging residues were 470 kg/msp3 and 540 kg/msp3. The moisture content in the stack was, on average 49% at the start and 48% at the end of the storage period. The dry matter loss in the stack during the storage period was on average, 4-5%, with large variations between different assortment range. The calorific heating value for different assortment ranges was between 20.09 - 20.70 MJ/kg DM before storage. The changes of energy during storage foremost depend on the changes in moisture content and losses of dry matter.

11016 **Monitoring the heat output of a wood-burning stove.** Modera, M.P. (Energy Performance of Buildings Group, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). *Heat Transfer Engineering;* 7: No. 1-2, 25-35(1986). Contract AC03-76SF00098.

To find a simple means for monitoring the heat output of a wood stove, general engineering models of heat transfer are used to develop a model that predicts the heat output of a stove from measurements of surface temperature. Using the surface area and the measured surface temperature as inputs, the model predicts the heat output of the stove by radiation and natural convection. As a means of verification, surface temperature data from four wood stoves monitored in a calorimeter room are used to make heat output predictions. The predicted heat outputs are then compared with the actual heat outputs measured by the calorimeter room. The predictions involve several potential monitoring schemes: (1) separate temperature measurements for each surface of the stove, (2) an average temperature measurement for all stove surfaces, and (3) a single surface temperature measurement. The accuracies of the predictions are characterized by their geometric bias and scatter as well as their predictions of total energy delivered. The scatter is a measure of the trackability of the model, analogous to the arithmetic standard deviation. Predictions made from average temperature measurements are found to be as accurate as those based on individual temperature measurements, whereas single-temperature measurements cause an additional 5% uncertainty in predictions. For both the average temperature and individual temperature predictions, the bias is between 2% and 24%, with 16% as the typical scatter. The trend in the bias is underprediction, possible causes of which are discussed at length.

13 HYDRO ENERGY

11017 **(DOE/ID/12128—1) [Small-Scale Hydroelectric Power Demonstration Project]: Jackson Bluff Hydroelectric Project: Final technical and construction cost report.** (Tallahassee, City of, FL (USA)). Sep 1986. Contract FC07-80ID12128. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003781.

This report describes the major steps undertaken by the City of Tallahassee to redevelop an old existing low-head hydroelectric station and, at the same time, demonstrate the commercial viability of such a venture. The report addresses the process of site selection, preliminary conceptual design for determining economic viability, licensing and the regulatory process, final design, and project construction.

1302 Site Geology And Meteorology

11018 **(NP—7750605) Preliminary investigation of hydroelectric power 1984-1985-1986 Paakitsup Akuliarusersua Ilulissat/Jakobshavn. Text.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Aug 1986. 97p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750605.

The investigation for a water power plant at the Paakistup Akuliarusersua bassin north east of Ilulissat/Jakobshavn was started in 1980. This report deals with the investigations carried out from the summer 1984 to the spring 1986. A part of the investigations from 1983 concerning materials for concrete production and roadbuilding at the fiord and materials for a dam at the outlet of lake '187' are presented. Further seismic soundings made in 1983 in the 'power plant-valley' and at the outlet of lake '187' are presented. The investigations, described in six minor reports, represents the basis of the final project which was published in May 1986. A general geological survey has been carried out in the area. More detailed geological investigations have been made on different alternatives and special focus has been put on the power tunnel, the power station and the outlet tunnel between lake '187' and the fiord. Eight core drillings were made, for instance at the intakes and the power plant. The drill holes have given information about rock quality and especially the rock temperature, that shows the bedrock is permafrossen. The inner part of the fiord and the socalled 'stroemsted' at the outlet of the fiord have been surveyed with the same equipment to investigate the admittance possibilities for larger ships.

11019 **(NP—7750606) Preliminary investigation of hydroelectric power 1984-1985-1986 Paakitsup Akuliarusersua Ilulissat/Jakobshavn. Appendix.** (Groenlands Tekniske Organisation, Copenhagen (Denmark)). Aug 1986. 229p. (In Danish). NTIS (US Sales Only), PC A11. File Number DE87750606.

The investigation for a water power plant at the Paakistup Akuliarusersua bassin north east of Ilulissat/Jakobshavn was started in 1980. This report deals with the investigations carried out from the summer 1984 to the spring 1986. A part of the investigations from 1983 concerning materials for concrete production and roadbuilding at the fiord and materials for a dam at the outlet of lake '187' are presented. Further seismic soundings made in 1983 in the 'power plant-valley' and at the outlet of lake '187' are presented. The investigations, described in six minor reports, represents the basis of the final project which was published in May 1986. A general geological survey has been carried out in the area. More detailed geological investigations have been made on different alternatives and special focus has been put on the power tunnel, the powerstation and the outlet tunnel between lake '187' and the fiord. Eight core drillings were made, for instance at the intakes and the power plant. The drill holes have given information about rock quality and especially the rock temperature, that shows the bedrock is permafrossen. The inner part of the fiord and the socalled 'stroemsted' at the outlet of the fiord have been surveyed with the same equipment to investigate the admittance possibilities for larger ships.

1306 Environmental Aspects

11020 **(AD-A—172710/6/XAB) Environmental and water-quality operational studies. Handbook on reservoir releases for fisheries and environmental quality. Final report.** Nestler, J.M.; Walburg, C.H.; Novotny, J.F.; Jacobs, K.E.; Swink, W.D. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Jul 1986. 98p. (WES/IR/E—86-3). NTIS, PC A05/MF A01.

This instruction report identifies and discusses many of the downstream environmental-quality effects of general reservior project operation, peaking hydropower operation, and flood control operation. Individual design and operation elements are identified, when possible, and the specific environmental effects of each are detailed under topic headings. Some of the topics addressed in this handbook include the effects of daily and weekly minimum low flows, effects of fall drawdown, effects of highly fluctuating flows, and relative effects of surface versus deep release. Each topic is defined and discussed; recommendations are presented which, in many cases, will alleviate the detrimental environmental quality effects of reservoir project operation.

11021 **(AD-A—172900/3/XAB) St. Stephen powerhouse tailrace velocity measurement. Final report.** Fagerburg, T.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Hydraulics Lab.). Sep 1986. 58p. (WES/MP/HL—86-6). NTIS, PC A04/MF A01.

Tests were conducted to provide a prototype evaluation of the operating conditions of the project and to evaluate the adequa-

cy of the repairs and remedial work performed in the channel downstream of the tailrace. Prototype measurements were made to define the relative magnitudes of velocities and the surface flow patterns in the channel downstream of the tailrace and the displacement, if any, of the stone protection material resulting from various turbine operations and tailwater conditions. Results of the data collection included determination of (a) velocity distribution at various ranges across the channel; (b) velocity profiles at the toe of the slope and at the observed location of highest velocity; and (c) unusual surface flow patterns that are produced by different combinations of turbine operations. Recommendations for start-up and shutdown procedures for the turbine operations that would produce the most acceptable. The depth soundings revealed that the stone protection material was quite stable (District surveys reveal that no appreciable displacement has occurred during the subsequent months of operation of the powerhouse.) The flow velocities were found to concentrate along the right side of the channel as a result of uneven flow distribution from the draft tube bays and the asymmetrical geometry along the left side of the tailrace. Return flows were observed and found to concentrate along the left side of the channel except when all three turbines were operating. Operating recommendations for the turbines are made based on tailwater conditions, length of time of nonoperation of the powerhouse, and the velocity data obtained from the tests.

1307 Power-conversion Systems

REFER ALSO TO CITATION(S) 11021

11022 **(EPRI-EL—4876) Rotor-mounted monitoring system for hydroelectric generators: Final report.** Churchill, T.L. (Spectra Technology, Inc., Bellevue, WA (USA)). Nov 1986. 56p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920121.

A rotor-mounted scanner (RMS) for salient-pole hydroelectric generators has been defined technically on the basis of both prior art and commercial availability of requisite components. Prior art information was acquired both by computer searching worldwide databases and by meeting with Bureau of Reclamation personnel, who have reduced the RMS concept to practice. Commercial availability was determined by surveying manufacturers and securing specification and data sheets for applicable products. Finally, a commercial version of the RMS has been defined and estimates made of the manufacturing sales price.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 11479

1401 Resources And Availability

REFER ALSO TO CITATION(S) 12278

11023 **Microprocessor-based rotating shadowband radiometer.** Michalsky, J.J.; Berndt, J.L.; Schuster, G.J. (Pacific Northwest Lab., Richland, WA). *Solar Energy;* **36**: No. 5, 465-470(1986). Contract AC06-76RL01830.

The authors have built and initially tested a microprocessor-controlled rotating shadowband photometer. A total horizontal solar radiation measurement is made once each minute. A corrected diffuse horizontal component is calculated from three measurements and direct normal solar radiation is calculated from these two quantities. The device can be initialized and interrogated for its accumulated data via a modem. The device is designed to require little or no maintenance; it should never need realignment, but will require occasional cleaning. Several channels of the logger are available for auxiliary measurements for the marginal costs of those sensors. These devices can be made in quantities of 50-100 at a cost of U.S. $1500 for parts and assembly. The pyranometer uses a silicon photodiode detector. For applications with tailored wavelength responses within 400-700 nm, such as photometric measurements, the device can be considered ready for use. Until corrections are derived for temperature, cosine, and spectral effects, the instrument's accuracy in a broadband solar resource measurement is low.

11024 **Empirical corrections to a rotating shadowband silicon cell pyranometer.** Michalsky, J.; Harrison, L.; LeBaron, B. (Pacific Northwest Lab., Richland, WA 99352). pp 177-179 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—).

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

Empirical corrections to a silicon cell pyranometer are derived. The corrections cause the silicon cell pyranometer to closely mimic the output of thermopile instruments. Daily integrated total horizontal, diffuse horizontal, and direct normal irradiances are within 1%, 3%, and 2.5% of thermopile values on the average. Ten-minute integrated values of these same silicon cell components seldom differ by more than 20 watts/m/sup 2/ from their thermopile counterparts. This paper is a report on our efforts to develop radiometric corrections for a rotating shadowband pyranometer using a silicon cell detector. Measurement systems using first-class pyranometers and pyrheliometers are expensive to buy and expensive to maintain, especially if one uses microprocessor-based trackers and data acquisition systems, and consequently inhibits widespread solar resource assessment.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 11064

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 10757, 11002, 11003, 11011, 11016, 11853, 11872, 11874, 12396, 12397, 12400, 12412

11025 **(DOE/CE/15239—T6) Photovoltaic membrane (PVM) roof system: Final technical report.** Francovitch, T.F. (Single-Ply Inst. of America, Inc., Pasadena, MD). 20 Nov 1986. Contract FG01-85CE15239. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002517.

The goal of the research performed was to test for shear and strain strengths of the combination of elastomeric membranes, adhesives and photovoltaic cells, that when placed in a laminated state with each other, would be able to survive in an external environment, with wind loads of 90 miles per hour or more. The first objective was to test the several combinations of elastomeric membranes, suitable adhesives and the photovoltaic cell in an attempt to establish a relationship with the cell membrane laminate to the applied load. Using the data obtained from the first series of tests, those samples which had successfully passed the shear tests were subjected to a second series of tests concentrating on the simulation of the external environmental forces of wind shear and strain on the samples. (LEW)

11026 **(DOE/ER/13188—3) Nitrogen control of photosynthetic protein synthesis.** Schmidt, G.W. (Georgia Univ., Athens (USA). Dept. of Botany). Sep 1986. Contract FG09-84ER13188. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002677.

Plant growth is severely affected by impaired photosynthesis resulting from nitrogen deficiency. The molecular aspects of this effect are being studied in the green alga Chlamydomonas grown in continuous culture systems. Photosynthetic membranes of nitrogen-limited cells are dramatically depleted in chlorophylls, xanthophylls and proteins of the light-harvesting complexes. In contrast, enzymes of the reductive pentose phosphate cycle and electron transport chain complexes are reduced only 40 to 65% on a per cell basis comparison with nitrogen-sufficient cultures. From analyses of mRNA levels by in vitro translation and hybridization analyses with cloned DNA sequences for photosynthetic proteins, we have found there are rather minor effects of nitrogen deficiency on nuclear or chloroplast gene transcription. Maturation of a transcript of the nuclear-encoded small subunit of ribulose 1,5-bisphosphate carboxylase is inhibited in nitrogen-deficient cells and causes accumulation of large amounts of mRNA precursors. Most of the effects of nitrogen deficiency on photosynthetic proteins appear to result from posttranscriptional regulatory processes: light-harvesting pro-

tein synthesis may be sustained but their import into chloroplasts or translocation to photosynthetic membranes is impaired. Nitrogen-deficient cells lack violaxanthin, a pigment that is essential for the structure, function and biogenesis of the major antenna complexes. The absence of this pigment may be a causative factor for the deficiency of light harvesting complexes. Finally, the accumulation of massive amounts of starch and triglycerides in nitrogen-limited cells indicate there are some genes whose maximal expression is dependent upon nitrogen-limiting conditions. 10 refs.

11027 (DOE/ER/13495—T1) **Anaerobic metabolism of aromatic compounds by phototrophic bacteria: Progress report.** Harwood, C.S.; Gibson, J. (Cornell Univ., Ithaca, NY (USA)). 19 Dec 1986. Contract FG02-86ER13495. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003570.

Vast quantities of aromatic compounds in the form of lignin, lignin derivatives, and aromatic pollutants are continually being introduced into the biosphere and much of this material accumulates in anaerobic environments. This project seeks to elucidate anaerobic routes of benzoate and 4-hydroxybenzoate metabolism by the photorophic bacterium, Rhodopseudomonas palustris. Recent evidence suggests that diverse aromatics must first be metabolized to form one or the other of these compounds prior to cleavage of the aromatic ring and so these pathways probably play general role as major degradative routes. R. palustris is particularly well suited for these studies because its ability to separate carbon metabolism from energy generating mechanisms frees it from the thermodynamic constraints that restrict the anaerobic metabolism of aromatics by pure cultures of fermentative bacteria. Studies include identification of the number and specificity of enzymes involved in benzoate and 4-hydroxybenzoate metabolism, identification of cofactors and electron carriers involved in each pathway, and a determination of the precise nature of the products formed. Mutants that are blocked in aromatic metabolism have been isolated. These mutants will be used, together with physiological approaches, to identify compounds (inducers and repressors) that regulate the expression of genes for aromatic degradation. 8 refs., 2 figs., 1 tab.

11028 (DOE/ER/13516—T1) **[Analysis of cyanobacterial photosystem 2 genes by cloning and mutagenesis]: Progress report, May 1986 to December 1986.** (Missouri Univ., Columbia (USA)). 1986. Contract FG02-86ER13516. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003689.

We have isolated proteins that appear to be regulated by changes in environmental conditions, either iron or light. Iron-regulated proteins include: a 36 kDa protein that is involved in iron-acquisition, and a 34 kDa intrinsic thylakoid chlorophyll-binding protein associated with PS II. Utilizing a lambda gtll library we have cloned and sequenced the 36 kDa protein and are performing site-directed mutagenesis to determine the function of the protein. Insertion of a transposon into this gene and transformation of the mutated gene into a wild type host resulted in a strain which is unable to grow under low-iron conditions. We have obtained a 42 kDa carotenoid-binding protein that is induced upon growth in high light conditions, and cloned the gene for this protein. We have also isolated a carotenoid-binding protein that is localized exclusively in the plasmalemma. We have also cloned the 33 kDa extrinsic magan-ese-binding protein that is involved in oxygen-evolution. The gene has been cloned and sequenced and contains a 28 amino acid signal sequence. 4 figs.

11029 (DOE/JPL—1012-109, pp 3-15) **Material requirements for high-efficiency silicon solar cells.** Wolf, M. (Univ. of Pennsylvania, Philadelphia). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Material requirements for high-efficiency silicon solar cells are outlined under the following topics: (1) primary causes of losses; (2) status of silicon solar cell technology; (3) the basic solar cell; (4) three principal paths to reduced recombination; (5) heavy doping: (6) knov¹edge of defects; (7) steps toward reduced number of recombination centers; and (8) low-cost crystalline silicon.

11030 (DOE/JPL—1012-109, pp 17-28) **Status of silicon ribbon growth technology for high-efficiency silicon solar cells.** Ciszek, T.F. (Solar Energy Research Institute, Golden, CO). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

More than a dozen methods have been applied to the growth of silicon ribbons, beginning as early as 1963. The ribbon geometry has been particularly intriguing for photovoltaic applications, because it might provide large area, damage free, nearly continuous substrates without the material loss or cost of ingot wafering. In general, the efficiency of silicon ribbon solar cells has been lower than that of ingot cells. The status of some ribbon growth techniques that have achieved laboratory efficiencies greater than 13.5% - edge-defined, film-fed growth (EFG), edge-supported pulling (ESP), ribbon against a drop (RAD), and dendritic web growth (web) is reviewed.

11031 (DOE/JPL—1012-109, pp 29-53) **Future application of Czochralski crystal pulling for silicon.** Matlock, J.H. (S.E.H. America, Vancouver, WA). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Czochralski (Cz) crystal pulling has been the predominant method used for preparing for silicon single crystal for the past twenty years. The fundamental technology used has changed little for 25 to 30 years. However, great strides have been made in learning how to make the crystals bigger and of better quality at ever increasing productivity rates. Recent efforts in Cz silicon development have concentrated on continuing the increase in wafer size and in higher productivity for lower costs. Also much effort has been devoted to the macroscopic and microscopic control of impurities in Cz crystals. Oxygen content is a special challenge for control as one must balance the dissolution rate of the quartz crucible, the free and forced convection in the silicon melt and the rate of surface evaporation. Much has been done by programming changes in the crystal growth parameters throughout the process.

11032 (DOE/JPL—1012-109, pp 55-80) **Potential productivity benefits of float-zone vs Czochralski crystal growth.** Abe, T. (Shin-Etsu Handotai, Gumma, Japan). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

An efficient mass production of single crystal silicon is necessary for ULSI fabrication, as well as high-efficient silicon solar arrays for the coming decade. However, it is anticipated that much difficulty to grow such volumes of crystals using conventional Cz method exists. The productivity of single crystals might increase with crystal diameter increase. The following two barriers for mass production are described: one is the long cycle time of operating due to slow-growth rate and large heat-capacity of the furnaces; the second is the large resistivity gradient along the growth direction of crystals due to impurity segregation. On the other hand, the possibilities of using the FZ method for mass production are described. Until now, this method has not been heavily used due to the technical and operational issues for growing crystals and the quality issues of the lack of intrinsic gettering and weakness from dislocation generation.

11033 (DOE/JPL—1012-109, pp 83-96) **New outlook on control of crystalline and chemical perfection during growth of silicon.** Witt, A.F. (Massachusetts Institute of Technology, Cambridge). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Significant progress has been made in our understanding of the Czochralski crystal growth process with the realization that the incorporation of oxygen into silicon is directly related to the inter-

nal gettering capability of wafers during device fabrication. Stringent oxygen concentration requirements in silicon brought about intensive studies of crucible (SiO_2) dissolution, oxygen accumulation in the melt, its transport to the growth interface, and its incorporation into the growing solid. In context, it was also recognized that the electronic properties exhibited by silicon during various stages of device fabrication were significantly affected by the thermal history of the silicon during the post-growth cool-down period. A comprehensive analysis of the heat and mass transport behavior in conventional Czochralski growth systems is described which resulted in the evolution of new concepts for their control.

11034 (DOE/JPL—1012-109, pp 97-107) **MCZ: striations in Cz silicon crystals grown under various axial magnetic field strengths.** Kim, G.K.M. (IBM East Fishkill Labs., Hopewell Junction, NY). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Suppression of fluid flow instabilities in the melt by the axial magnetic field in Czochralski silicon crystal growth (AMCZ) was investigated precisely by a high-sensitivity striation etching in conjunction with temperature measurements. The magnetic strength (B) was varied up to 4.0 kG, incremented in 0.5 kG/5 cm crystal length. The convection flow was substantially suppressed at $B > 1.0$ kG. A low oxygen level of 2-3 ppm and a high resistivity of 400 ohm-cm was achieved in the AMCZ silicon crystals at $B \geq 1.0$ kG. Details of the striation formation as a function of B are presented. Computer simulation of the magnetohydrodynamics of the AMCZ silicon crystal growth is discussed briefly with regard to the solute, especially oxygen segregation ab B=0, 1.0, and 2.0 kG. Earlier studies in the inverted Bridgman growth of InSb and Ge are reviewed, which established the cause and effect relationship between the convection in the melt and the striation formation as well as the suppression of the convections in the melt by transverse magnetic field.

11035 (DOE/JPL—1012-109, pp 109-121) **High purity low defect FZ silicon.** Kimura, H.; Robertson, G. (Hughes Research Labs., Malibu, CA). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

The most common intrinsic defects in dislocation-free float zone (FZ) silicon crystals are the A- and B-type swirl defects. The mechanisms of their formation and annihilation have been studied by Petroff and de Kock, Foell, Goesele and Kobesen, and others. Another type of defect in dislocation-free FZ crystals, found by Roksnoer and van den Boom is referred to as a D-type defect. Concentrations of these defects can be minimized by optimizing the growth conditions and the residual swirls can be reduced by the post-growth extrinsic gettering process. Recently, a transverse magnetic field was applied during the FZ growth of extrinsic silicon. The objective was the study of the spatial distribution of the major dopant, under the assumption that the magnetic field would reduce fluctuations in the flow occurring in the melt and thus in the dopant concentration. Melt flow in the directions parallel and perpendicular to the field are distinctly different. It is believed that the magnetic field offers a unique experimental tool to help elucidate the mass and energy transport occurring in the float zone process.

11036 (DOE/JPL—1012-109, pp 123-143) **Defects in silicon effect on device performance and relationship to crystal growth conditions.** Jastrzebski, L. (RCA Labs., Princeton, NJ). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

A relationship between material defects in silicon in performance of electronic devices is described. A role which oxygen and carbon in silicon play during defects generation process is also discussed. Electronic properties of silicon are a strong function of the state in which oxygen is in silicon. These various states control mechanical properties of silicon efficiency of internal gettering and formation of defects in device active area. In addition to temperature, time, ambient, cooling/heating rates of high temperature treatments, the oxygen state is a function of crystal growth process. It is well documented that incorporation of carbon and oxygen into silicon crystals is controlled by geometry, and rotation rates applied to the crystal and crucible during crystal growths. Also, formation of nucleation centers for oxygen precipitation is influenced by the growth process, although there is still a controversy which parameters play a major role. All these factors are reviewed with the special emphasis on the areas which are still ambiguous and controversial.

11037 (DOE/JPL—1012-109, pp 147-173) **Simulation of the temperature distribution in crystals grown by Czochralski method.** Dudukovic, M.P.; Ramachandran, P.A. (Washington Univ., St. Louis, MO). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Production of perfect crystals, free of residual strain and dislocations and with prescribed dopant concentration, by the Czochralski method is possible only if the complex, interacting phenomena that affect crystal growth in a Cz-puller are fully understood and quantified. Natural and forced convection in the melt, thermocapillary effect and heat transfer in and around the crystal affect its growth rate, the shape of the crystal-melt interface and the temperature gradients in the crystal. The heat transfer problem in the crystal and between the crystal and all other surfaces present in the crystal pulling apparatus is discussed.

11038 (DOE/JPL—1012-109, pp 175-191) **Convective effects in float-zone and Czochralski melts.** Neitzel, G.P. (Arizona State Univ., Tempe). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

The hydrodynamics of crystal-growth melts is a relatively new research area. Numerical modeling of these processes is necessary, considering the hostile environment from the standpoint of laboratory experimentation. The work discussed is in two parts: numerical simulations are being conducted of the flow in a Czochralski melt and also of that in a float zone. In addition, for the float-zone case, energy stability theory is used to determine stability bounds for the onset of oscillatory thermo-capillary flow. Computations will be performed for each of the basic states under conditions of variable gravity to examine the possibilities for space processing by this technique. The consideration of the proposed basic states will allow comparisons with previous analytical work and model experiments. These will assist greatly in the development and verification of the model.

11039 (DOE/JPL—1012-109, pp 195-214) **Thermal-capillary model for Czochralski growth of semiconductor materials.** Derby, J.J.; Brown, R.A. (Massachusetts Institute of Technology, Cambridge). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Over 80% of the silicon used by the electronics industry is grown from the melt by the Czochralski (CZ) crystal growth process. A single crystal boule is slowly pulled from a pool of melt maintained by heating the outside of the crucible. Surface tension acts against the force of gravity to form a meniscus connecting the growing crystal to the surface of the melt pool. The precise temperature gradient needed to sustain the solidification of nearly perfect crystalline solid is maintained by a cooler ambient above the crucible. The crystal and crucible are rotated to minimize thermal asymmetry in the system. In addition, as the melt level drops during growth, the crucible is raised by movement of the pedestal so that the solidification front remains in a specified region of the heater. The thermal-capillary method for the growth of this material is described.

11040 (DOE/JPL—1012-109, pp 215-233) **Impurities in silicon solar cells.** Hopkins, R.H. (Westinghouse R & D Center, Pittsburgh, PA). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

How metallic impurities, both singly and in combinations, impact the performance of silicon solar cells was studied. Czochralski silicon web crystals were grown with controlled additions of secondary impurities. The primary electrical dopants were boron and phosphorus. The metal elements were selected because of their occurrence in silicon raw materials, possible introduction during subsequent device processing, or because there were common construction materials for process equipment or the cells themselves. Some 26 elements were examined including Ag, Au, Al, C, Cr, Co, Cu, Fe, Gd, Mn, Nb, Ni, Pd, Sn, Ta, Ti, V, W, and Zr. Impurity concentrations were in the range of 10^{11} to 10^{16} cm^{-3}. The redistribution of impurities during silicon web growth was examined and it was found that, like Czochralski silicon growth, the segregation coefficients for metals are small, typically 10^{-7} to 10^{-5}. In addition, the performance loss of web cells due to impurities can be modeled in a fashion identical to that employed for devices made on Czochralski wafers. The predicted and measured cell performance values are in good agreement.

11041 (DOE/JPL—1012-109, pp 235-257) **Oxygen and carbon in silicon.** Corbett, J.W. (State Univ. of New York, Albany). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

The properties of the early transistors were determined by the minority-carrier lifetime, as is the silicon photovoltaic solar cell. Most of the devices on the modern integrated circuits are majority carrier devices, in part to avoid this lifetime dependence. It is pertinent to note that the micro-electronics industry typically starts with wafers with a minority-carrier lifetime of ca. 1000 micro-seconds, but during device fabrication this lifetime is reduced to below ca. 1 micro-second, in spite of extraordinary cleanliness and precautions. Process-induced defects (PID) are the cause of this lifetime reduction, but PID is a rubric covering many poorly identified defects or unidentified defects. These defects include point defects, defect complexes, line defects, and bulk precipitates. Some ideas about the nature of recombination at point defects and point defects complexes are discussed, but one of the aspects that needs to be understood is the nature of minority carrier recombination at line defects and at precipitates. Recent work on the thermal donors is providing a great deal of insight into the structure of the precipitates and has promise of leading to an understanding of the complex processes associated with oxygen in silicon. The results are discussed.

11042 (DOE/JPL—1012-109, pp 259-277) **Solar cell and I.C. aspects of ingot-to-slice mechanical processing.** Dyer, L.D. (Texas Instruments Inc., Sherman). 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

Intensive efforts have been put into the growth of silicon crystals to suit today's solar cell and integrated circuit (I.C.) requirements. Each step of processing the crystal must also receive concentrated attention to preserve the grown-in perfection and to provide a suitable device-ready wafer at reasonable cost. A comparison is made between solar cell and I.C. requirements on the mechanical processing of silicon from ingot to wafer. Specific defects are described that can ruin the slice or can possibly lead to device degradation. These include grinding cracks, saw exit chips, crow's-foot fractures, edge cracks, and handling scratches.

11043 (DOE/JPL—1012-109, pp 279-291) **Defects and device performance.** Storti, G.; Armstrong, R.; Johnson, S.; Lin, H.C.; Regnault, W.; Yoo, K.C. 15 Aug 1985. NTIS, PC A13/MF A01. File Number DE86010241. (CONF-8412106—; JPL-PUB—85-59).

From Workshop on crystal growth for high-efficiency silicon solar cells; San Diego, CA, USA (3 Dec 1984).

The necessity for a low-cost crystalline silicon sheet material for photovoltaics has generated a number of alternative crystal growth techniques that would replace Czochralski (Cz) and float-zone (FZ) technologies. A major thrust with these alternative techniques has been to increase the efficiency of FZ and Cz silicon. At present, efficiencies of devices fabricated from low resistivity FZ silicon are approaching 20%, and it is highly likely that this value will be superseded in the near future. FZ silicon has an advantage in obtaining this goal since sufficiently long-minority carrier lifetimes are possible at low resistivities ($\approx$ 0.1 ohm-cm). However, FZ silicon is expensive, and is unlikely ever to be used for photovoltaics. It is likely that 20% efficient solar cells can be fabricated from both FZ and Cz silicon, but costs are likely to be ultimately unacceptable. Alternate silicon technologies are not likely to achieve this goal, but cost per watt figures may be eventually better than either of the single crystal technologies and may river any thin-film technology.

11044 (DOE/JPL/955843—82/1-Final) **Large-area sheet task: Advanced dendritic web growth development: Final report, October 1980 to May 1985.** (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1985. Contract NAS-7-100-955843. 239p. NTIS MF A01; 2; GPO Dep. File Number DE87003821.

The web process produces thin single crystal silicon ribbons directly from the melt without shaping dies. Long, low defect density ribbons have been grown with continuous replenishment. Computerized models are used to calculate the temperature, stress, and deformation behavior of the thin ribbons. One result of the computer analysis was the introduction of the concept of a vertical thermal element. A second productive application of computer models was to map temperature distributions and potential convective flow conditions in the silicon melt. A third modeling activity led to a method to estimate the temperature of the various thermal elements from the power input of the induction soil. The major focus of the experimental work was to relate the model predictions to actual growth conditions and, in turn, to the structure of the crystals produced. A comprehensive test scheme was devised to characterize the crystals produced. Studies of width-controlled continuous replenishment were carried out. Implementation of an automated data acquisition system capable of monitoring and storing data from eleven web growth furnaces was completed. Development of a completely automated closed loop web growth control was initiated. Software for a furnace control algorithm based on dendrite thickness was written and tested using computer simulation. (LEW)

11045 (FOK-TR-R—5-068) **High power solar array (HPSA) study. Final report.** Hegemans, G.J. (Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.). Jun 1985. 110p. (ESA-CR(P)—2182; ETN—86-97795). NTIS, PC A06/MF A01.

The design of a 30 kW planar Si-cell solar array for space shuttle payloads along with a GaAs-concentrator array are presented. Both arrays consist of blankets supported by a central, coplanar telescopic mast. Analysis results describing the array performances are summarized. A design and development philosophy is presented, critical design areas are pinpointed, and descoping/growth capability, orbital replacement units, and extravehicular servicing are discussed.

11046 (ORNL/TM—10201) **Determination of effects of atmospheric contamination on photovoltaic cells in concentrating systems.** Kaplan, S.I. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004024.

Three sets of single-crystal silicon photovoltaic (PV) cells were irradiated in a reflective concentrating solar collector at Oak Ridge National Laboratory (ORNL). The objective was to examine whether the effects of concentrated sunlight would affect airborne particulate material depositing on the cells or their cover glasses, causing removal-resistant layers that would seriously attenuate insolation reaching the cells. Four types of cell assembly specimens were deployed in each of the three sets: (1) coverglass clamped to face of PV cell, with embossed face of glass away from cell; (2)

coverglass clamped to face of PV cell, with embossed glass surface toward cell; (3) cover glass spaced above cell with 1.6-mm air gap, with embossed side out; (4) cover glass spaced above cell with 1.6-mm air gap, with embossed side toward cell. The sets were exposed for periods of up to 162 days, between October 1962 and September 1963. The observed results were negative: no unusually adherent deposits were found, and the observed light attenuation was typical of that routinely observed in comparable exposure durations with nonconcentrating PV arrays. In an auxiliary experiment, a silicon PV cell of construction similar to those in the main experiment was recovered, together with fragments of its surrounding pottant, from a damaged receiver used in a reflective solar concentrator at the array at Mississippi County Community College in Arkansas. These materials were subjected to x-ray spectrographic analysis to determine whether elemental silver had migrated from the collector grid of the cell into the adjacent pottant. The result was negative, supporting previous evidence from flat-plate arrays concerning the resistance of these cells to such damage. At the conclusion of the above test series, the concentrator assembly was transferred to the Florida Solar Energy Center.

11047 (SERI/STR—211-2978) The preparation of thin films for photovoltaic conversion by novel MOCVD [metal-lorganic chemical vapour deposition] techniques: Annual subcontract report, 15 February 1985-15 April 1986. Saunders, A.; Vecht, A. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1986. Contract AC02-83CH10093. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001116.

This report describes research done on the synthesis and evaluation of new source materials for metal-organic chemical vapor deposition (MOCVD) of thin-film photovoltaic materials. Thin films of ZnS, CdS, and In_2S_3 have been grown from a new class of MOCVD source materials. Although film growth and characterization are at an early stage of development, this new approach is a step toward the development of a low-cost, large-scale method of deposition high-conductivity Zn/sub x/Cd/sub 1-x/S. In thin films. A second task, the development of new source materials for Cu In Se_2 thin-film deposition, has not yet been completed. The synthesis of an organometallic compound capable of liberating Cu/sub x/Se has been achieved. Similar work remains to be done for In_2Se_3.

11048 (SI—1-1985) Horse bunching of small trees from thinnings. Dekking, J.W.C. (Skovteknisk Inst., Copenhagen (Denmark)). 1985. 15p. (In Danish). Skovteknisk Institut. EFP-84.

In many forest districts trees are growing in tight rows and fully mechanized felling and bunching is impossible. Manual felling and sawing followed by horse bunching can solve the problem in wood thicket. Bunching of common spruce was investigated with regard to economy. (EG).

11049 (SLU-ESO—34) Gross morphology and anatomy of current shoots of Salix. Brunkener, L. (Swedish Univ. of Agricultural Sciences, Uppsala. Energy Forestry Project). 1984. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750616.

The investigation was made on current shoots of 4-year-old stools which had been cut down annually. The aim of this preliminary study was to describe the features of the macrostructure of the shoot, the organization and activity of the vegetative shoot apex, the meristematic activity and cell enlargement in the internodes and the tissue differentiation. Each bud generally gave rise to three shoots. The variation in length of long shoots seemed to depend more on differences in average growth rate than on differences in the duration of the growing period. The strong variations in the rate of length growth as well as radial growth in early summer were connected with changes in temperature. In elongating region of the stem showed seasonal variations in length but was usually 10-20 cm long during the period of highest growth rate. In Salix viminalis the region mostly included 50-70 internodes, of which most were located within the shoot tip. The termination of radial growth occured approximately at the same time as the length growth finished. The mitotic activity in cortex and pith ceased completely or almost completely about 5 cm from the shoot apex. Thus, the elongation and the primary radial growth of the shoot below this level wholly or almost wholly depended on cell enlargement. The first signs of the presence of an active cambium were seen only 1-2 cm from the shoot apex.

11050 (SLU-ESO—37) Frosts during the growing season. Frequency of occurrence and effects on current energy forestry. Christersson, L.; Fircks, H. von; Perttu, K. (Swedish Univ. of Agricultural Sciences, Uppsala. Energy Forestry Project). 1984. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750617.

Frost during the summer is very common in Sweden. Two kinds of summer frosts exists; one is called advection frost which is caused by cold air coming down over the country from the north and the other is an inversion frost caused by long-wave radiation from the ground taking place during calm clear nights. In this way the air closest to the ground is cooled. Eleven experimental areas are described as regards prehistory, vegetation, frequency of summer frosts, and energy forestry tests in progress. The amount of frost injuries is reported. Differences in frost hardiness of fast growing Salix clones in the growing state have been demonstrated. The results support the idea that the formation of ice crystals inside the growing tissues always take place around -2 degree C and that this ice crystal formation damages the growing part of the shoot of all tested clones. A fast growing shoot of Salix species has a longer elongation zone and this explains why a fast-growing shoot is more severly damaged than a slowly growing one at the same frost temperature. If the different clones are in a growing state there are only small differences in the amount of frost damage. On the other hand, there are great differences between the clones in the capacity of the surviving lateral buds to sprout. This capacity is foremost seen in clones of the species Salix dasyclados. Two year older shoots of different Salix species have never been damaged by summer frost because summer frosts do not reach the elongating zone of these shoots. In conclusions measures are listed on how to prevent or decrease the injuries caused by summer frosts. With 21 refs.

11051 (SLU-ESO—38) Infection patterns and host differences in Melampsora attacks on Salix plantations. Roennberg-Waestljung, A.C.; Gunnerbeck, E. (Swedish Univ. of Agricultural Sciences, Uppsala. Energy Forestry Project). 1985. 40p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750618.

Attacks of Melampsora epitea s. lat. were studied in eight Salix plantations in southern and central Sweden during the autumn of 1983. Degrees of attack were estimated according to a scale of twelve degrees. S. viminalis and S. dasyclados showed significantly different infection patterns. The total infection on S. dasyclados was heavy and developed rapidly for one site. S. viminalis was less heavyly attacked and the infection developed more slowly. No infection was seen on S. alba or S. fragilis. Comparisons between uredospores from one clone of each S. dasyclados and S. viminalis showed that the spores differ significantly in lenght and width between the two clones at all the six sites where both clones are grown. Also the length/width ratio differs significantly at four of the six sites. Teliosspores from the two clones differed significantly in length at all except one of the sites. The differences in infection pattern and spore measurements between the two clones suggest that different taxa of the fungus may be present although it cannot be excluded that physiological or anatomical differences beteween host clones cause phenotypic differences in the fungi.

11052 (SLU-ESO—39) Site descriptions of Swedish energy forests. Background data from a plant conservation study. Gustafsson, L. (Swedish Univ. of Agricultural Sciences, Uppsala. Energy Forestry Project). 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750619.

Ten sites with Salix-coppices (including 12 stands) are described regarding climate, position in the Swedish National Grid, province, elevation, size, bedrock, quaternary deposits, soil, former vegetaion and land use, year of planting, soil-cultivation, ditching, crop, fertilization, harvesting, weed control and condition of plantation. A map and a black and white photograph of each coppice are presented. The coppices were analysed botanically (ground vegeta-

tion) in 1981-1982. The results of this analysis are presented in a separate paper. The study was part of a project on energy forestry from a plant conservation viewpoint. With 24 refs.

11053 **(SLU-ESO—40) Role of meteorology in Swedish conventional and short-rotation forestry.** Perttu, K. (Swedish Univ. of Agricultural Sciences, Uppsala. Energy Forestry Project). 1985. 34p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750620.

General forest research as well as forestry practices are largely dependent on meteorological and climatological results. It is therefore, of great importance that forest meteorology is devoted enough attention. The objective of this paper is to give a summary of the role that forest meteorology plays, especially in Swedish forestry. Most of the results have been taken from investigations performed in Sweden. Similar research conducted in other countries (e.g. Germany, Norway, the UK and the USA) has, of course, had an obvious influence on this research during the years. Forest meteorological investigations can be divided into research on general climate, local- and microclimate and bio and micrometeorology. At latitudes north of 50-55/sup/(o), temperature is one of the most limiting factors for growth. Many expressions have been presented to explain either the temperature influence itself or some other variable closely related to temperature. Length of growing season, heat sums, growth units and respiration-equivalents are given such expressions. When a forest canopy is removed the microclimate is drastically altered close to the soil surface. Frost frequencies usually increase considerably. By leaving a sparse shelter canopy, this risk can be reduced by 50% or more. With 35 refs.

11054 **(STEV-EO—86-5) Large scale trial Storfoersoek Syd. Cultivation of energy forests in the south of Sweden. Report stage 4.** Perman, G. (Statens Energiverk, Stockholm (Sweden)). May 1986. 67p. (In Swedish). NTIS (US Sales Only), PC A04. File Number DE87750626.

The experience from the energy forest project shows that the economy today is not equivalent to traditional corn production. To achieve this better planting material and more effective harvest and chipping technique is necessary. This winter around 20 hectares have been harvested and chipped. The technique has functioned well but is not yet commercial. Burning tests show the problem of burning wood chips with a high moisture content. Part of the chips has been pelletized and burned in small burners. The discussion about the surplus situation of the traditional corn production motivates increased efforts in energy forestry development.

11055 **(TVA/ONRED/LER—86/36) Biomass for liquid fuels in the 201-county Tennessee Valley Region.** (Tennessee Valley Authority, Knoxville (USA). Div. of Land and Economic Resources). Aug 1986. 75p. NTIS, PC A04/MF A01. File Number DE87900344.

This report discusses the hardwood resource in the 201-county Tennessee Valley region suitable for liquid fuel production and addresses forest management, harvesting, and some environmental concerns. Biomass data are presented for 23 procurement areas and for each county within these areas. The findings show 11 procurement areas can support a 1000 oven-dry tons per day, and 12 areas can support a 500 oven-dry tons per day liquid fuel plant. The US Forest Service data show 6.3 million oven-dry tons of hardwood biomass are available each year in this region. In addition, there is enough biomass in the form of logs, poles, and pulpwood bolts for the existing forest products industry. Softwoods are not considered in this report. 8 refs., 24 figs., 12 tabs.

11056 **(TVA/ONRED/LER—87/11) Mineral content of wood in selected Tennessee Valley hardwoods.** Parrish, W.A.; Groton, E.S.; Scanlon, D.H. (Tennessee Valley Authority, Norris (USA). Div. of Land and Economic Resources). Nov 1986. 70p. NTIS, PC A03/MF A01. File Number DE87900342.

The mineral content of wood, because of its neutralizing capacity, has a measurable effect on the acid hydrolysis process of making fuel-grade ethanol. To determine if there might be measurable differences in mineral content of the feedstock obtained from different locations and species, wood samples were collected from different sites in procurement areas designated for two potential ethanol-producing facilities. These samples were analyzed for nine minerals (calcium, potassium, magnesium, sodium, iron, aluminum, copper, manganese, and phosphorus). Results show high mineral content variability between different hardwood species, individual trees, and locations. Some species have more than 10 times the amount of a given mineral than other species. This indicates that processing costs and operating parameters of converting wood to ethanol may be affected by species selection and mix. 12 refs., 6 figs., 7 tabs.

11057 **Strongly luminescing ruthenium(II)/ruthenium(II) and ruthenium(II)/platinum(II) binuclear complexes.** Sahai, R.; Baucom, D.A.; Rillema, D.P. (Univ. of North Carolina, Charlotte). *Inorganic Chemistry;* **25**: No. 21, 3843-3845(8 Oct 1986). Contract FG05-84ER13263.

Two strongly luminescing complexes, ruthenium(II)/ruthenium(II) homobinuclear complex and ruthenium(II)/platinum(II) heterobinuclear complex, have been prepared and characterized. The organic part of the complex is 4,4'-dimethyl-2,2' bipyridine dimer. The luminescence behavior of the homobinuclear and heterobinculear complexes was found to be comparable to that of $Ru(bpy)_3^{2+}$, although the luminescence maxima were shifted from 615 to 620 nm. These complexes exhibit good stability due to the bidentate chelating capability of the bridging ligand. These new complexes can provide the opportunity for detailed photophysical studies related to donor-acceptor interactions and to the possibility of two simultaneous single-electron transfer events. 17 references, 2 figures.

11058 **Status of chemical vapor deposition methods for hydrogenated amorphous silicon.** Stafford, B.; Sabisky, E. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 409-412 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—).

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

Chemical vapor deposition (CVD) is an effective method for producing efficient hydrogenated amorphous silicon (a-Si:H) photovoltaic cells. The general class of chemical vapor deposition, which includes glow discharge, photo-CVD, thermal CVDE, and laser-induced CVD, is reviewed.

11059 **Dependence of rate constants for photoinduced charge separation and dark charge recombination on the free energy of reaction restricted-distance porphyrin-quinone molecules.** Wasielewski, M.R.; Niemczyk, M.P.; Svec, W.A.; Pewitt, E.B. (Argonne National Lab., IL). *Journal of the American Chemical Society;* **107**: No. 4, 1080-1082(1985). Contract W-31-109-ENG-38.

Rate constants for both radical ion pair formation and recombination in porphyrin - quinone donor-acceptor molecules are reported. The ion pair formation and recombination depend on the exothermicity of the respective electron-transfer reaction in a manner previously reported. The question as to what fraction of energy change is due to relaxation processes involving the solvent vs. the porphyrin - quinone molecules has not been answered by these studies. However, the measured reorganization energy was found to be approximately solvent independent. It was observed that in these molecules the donor-acceptor distance is restricted, and the highly exothermic charge recombination reactions do not produce electronically excited states to the donor or acceptor. 11 references, 2 figures.

1406 Photovoltaic Power Systems

11060 **(DOE/CE/30701—T9) SMUDPV2: Quarterly performance report 2 for the period July through September 1986.** Collier, D.E. (Sacramento Municipal Utility District, CA (USA)). Oct 1986. Contract FC03-82CE30701. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002942.

The performance of the nominal 1 MW/sub AC/ photovoltaic power plant located adjacent to the Rancho Seco generating station in California is reported for the months of July, August, and

September 1986. The performance data presented were measured, stored, and reduced by the onsite plant control and data acquisition computer. Data pertaining to operating and maintenance activities were obtained from the operator's log. (LEW)

11061 **(ETN—6-97255) Photovoltaic power system design for telecommunications.** Garner, I.F. (British Petroleum Co. Ltd., Sunbury-on-Thames). 1985. 9p. NTIS, PC A02/MF A01.

The use of photovoltaic power systems for telecommunications, particularly in rural areas, is reviewed. Operating costs and maintenance are discussed. System design, including the collection of insolation data and the calculation of system capacity, is treated. Increasing reliability of photovoltaic modules and storage batteries is noted. The advantages of relay switching over solid state are outlined. Array mountings are described.

11062 **High-efficiency photovoltaics: Key to widespread use of PV.** Leboeuf, C.M.; Benner, J.P. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 380-383 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—).

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

Salient features of high-efficiency photovoltaic devices for flat-plate and concentrator terrestrial applications, fabricated from alloys of gallium arsenide, are discussed. The rationale for investigating high-efficiency devices, including their potential for cost-effectiveness and relationship to the National Photovoltaics Program's goals, is presented. A brief description of several promising device concepts is given, together with a summary of the most recent advances in the SERI Advanced High-Efficiency Concepts Program.

11063 **Assessment criteria for photovoltaic technologies.** McConnell, R.D. (Solar Energy Research Institute, Golden, CO 80401). pp 384-387 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—).

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

The identification and use of assessment criteria, such as the criteria discussed in this paper, are not meant to inhibit imagination and creativity but rather to bring consistency and objectivity to the evaluation process needed in the technical management of high-risk research. The assessment method has its limitations, since estimates and approximations are necessary to provide the information and data needed to answer the ultimate question of photovoltaic technology assessment: Will the technology be cost effective?

11064 **Effects of chronic continuous wave microwave radiation (2.45 GHz) on the foraging behavior of the white-throated sparrow.** Wasserman, F.E.; Patterson, D.A.; Kunz, T.H.; Battista, S.P.; Byman, D. (Boston Univ., MA). *Space Solar Power Review;* 6: No. 2, 99-105(1986).

The effect of chronic continuous wave microwave radiation on the foraging behavior of the White-throated Sparrow was examined using an optimal foraging laboratory technique. Birds were exposed to microwaves for seven days at a frequency of 2.45 GHz and power densities of 0.0, 0.1, 1.0, 10.0, and 25.0 mW/cm^2. Even though there were differences in foraging behaviors among power densities no trend was found for a dose response effect. Birds showed no significant differences in foraging behaviors among pre-exposure, exposure, and post-exposure periods.

1407 Solar Thermal Power Systems

11065 **(DOE/NASA—0181) Brayton cycle solarized advanced gas turbine: Final report.** (Garrett Turbine Engine Co., Phoenix, AZ (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1986. Contract AI01-77CS51040. 129p. (NASA-CR—179559; GARRETT—31-6190). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87003993.

This report describes the development of a Brayton Engine/Generator Set for solar thermal to electrical power conversion, authorized under DOE/NASA Contract DEN3-181. The program objective was to design, fabricate, assemble, and test a small, hybrid, 20-kW Brayton-engine-powered generator set. The generator set, also called a power conversion assembly (PCA), is designed to operate with solar energy obtained from a parabolic dish concentrator, 11 meters in diameter, or with fossil energy supplied by burning fuels in a combustor, or by a combination of both (hybrid mode). The PCA consists of the Brayton cycle engine, a solar collector, a belt-driven 20-kW generator, and the necessary control systems for automatic operation in solar-only, fuel-only, and hybrid modes to supply electrical power to a utility grid. The original configuration of the generator set, known as the Mod "0" System, incorporated the recuperated GTEC Model GTP36-51 gas turbine engine for the PCA prime mover. However, subsequent development of the GTEC Model AGT101 under DOE/NASA Contract DEN3-167 led to selection of the regenerated AGT101 as the power source for the PCA. Performance characteristics of the AGT101-powered PCA, thermally coupled to a solar collector (provided by Sanders Associates, Inc.) for operation in the solar mode, are presented in the report. The PCA was successfully demonstrated in the fuel-only mode at the GTEC Phoenix, Arizona, facilities prior to its shipment to Sandia National Laboratory in Albuquerque, New Mexico, for installation and testing on a test bed concentrator (parabolic dish). Considerations relative to Brayton-engine development using the all-ceramic AGT101 when it becomes available, which would satisfy the DOE heat engine efficiency goal of 35 to 41%, are also discussed in the report.

11066 **(SAND—85-2422) Reliability study of Solar One, the central receiver pilot plant.** Nagel, J.F. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1986. Contract AC04-76DP00789. 118p. NTIS, PC A06/MF A01. File Number DE86014082.

Solar One, the world's largest electric power generating plant to use a solar central receiver as its energy source, is well into its commercial power production phase. A reliability model of the plant was developed, and the reliability of the plant and its various systems and subsystems was assessed. Included is a separate assessment of the heliostats (sun-directing mirrors). As a result of the assessments, various problems and reasons for these problems were studied. Recommendations for similar future designs are included.

11067 **(SAND—86-0289) Heat engine development for solar thermal dish-electric power plants.** Linker, K.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003583.

The Department of Energy's (DOE) Solar Thermal Program has as one of its program elements the development and evaluation of heat engine technologies that are applicable to Distributed Receiver Systems. The primary research and development activities, for the past several years, have involved the so-called dish-electric concept in which a heat engine, solar receiver, and generator are coupled and located at the focus of a parabolic dish concentrator. Power conversion assemblies (PCA) would be deployed at the size of about 25 to 50 kWe, which is consistent with concentrator development in the 11 to 15 m diameter range. This report describes various heat engine cycles, outlines the status of their development, presents test data and performance evaluation from experimental work to date, and discusses the strategy for future development efforts.

11068 **(SERI/SP—272-3008) Solar Thermal Technology Program bibliography, 1973-1985.** (Solar Energy Research Inst., Golden, CO (USA)). Dec 1986. Contract AC02-83CH10093. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86010728.

This bibliography contains citations of technical publications that have emerged from the US Department of Energy's Solar Thermal Technology (STT) Program. The entries include research performed at the federal laboratories and at various universities and other organizations under subcontract to the US Department of Energy or its laboratories from 1973 through 1985. The types of

references include journal articles, papers presented in conference proceedings, monographs, chapters in monographs, technical reports, and patents. The citations are divided into chapters by federal laboratory where the research was performed or where the subcontract was monitored. Although there may be some crossover among the laboratories, each one has traditionally had certain areas of responsibility. The first chapter contains citations from the Jet Propulsion Laboratory, which directed most of the parabolic dish technology research. The second chapter, Sandia National Laboratory/Albuquerque, lists documents primarily for distributed receiver technology as well as documents pertaining to the Central Receiver Test Facility (CRTF), which is located in Albuquerque. The third chapter, Sandia National Laboratory/Livermore, contains references for central receiver technology. The documents on central receiver technology that resulted from contracts managed by the US Department of Energy San Francisco Operations Office are also included in the third chapter. The fourth chapter, Solar Energy Research Institute, contains citations documenting advanced research concepts.

11069 **Heat engine development for solar thermal dish-electric power plants.** Linker, K.L. (Sandia National Labs., Albuquerque, NM). pp 296-299 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—). Contract AC04-76DP00789.

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

The Department of Energy's (DOE) Solar Thermal Program has as one of its responsibilities the development and evaluation of heat engine technologies which are applicable to Distributed Receiver Systems. The primary research and development activities, for the past several years, have involved the so-called dish-electric concept in which a heat engine, solar receiver, and generator are coupled and located at the focus of a parabolic dish concentrator. Power conversion assemblies (PCA) would be deployed at the size of about 25 to 50 kWe which is consistent with concentrator development in the 11-15m diameter range. This report will outline the status of heat engine development, present test data and performance evaluations from experimental work to date, and discuss the strategy for future development efforts.

1408 Ocean Energy Systems

11070 **(EPRI-AP—4921) Ocean energy technologies: The state of the art: Final report.** Carmichael, A.D.; Adams, E.E.; Glucksman, M.A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Ocean Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 144p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920110.

A state-of-the-art study of ocean energy technologies has been conducted to evaluate their potential use for the generation of electrical power. The more developed technologies are tidal energy, ocean thermal energy conversion (OTEC), and wave energy. In addition there has been a demonstration of a small ocean current turbine, and proposals have been made for salinity gradient devices and ocean wind turbines. Energy costs were estimated for representative base case systems for tidal, OTEC, and wave energy projects. The tidal energy scheme was predicted to have the lowest energy costs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 11082

11071 **(DOE/SF/12217—1) Comparative systems analysis of solar building heating, cooling and hot water research and development (R and D) alternatives: Final report.** Bankston, C.A.; Breger, D.S. (CBY Associates, Inc., Washington, DC (USA)). Nov 1986. Contract AC03-84SF12217. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003398.

This report presents the results of the second phase of an evaluation process that was initiated in 1981, to provide the US Department of Energy with quantitative evaluation of the potential of various research and development opportunities for the application of active solar energy systems to the heating and cooling of buildings. The methodology employed in the study is based upon the methods and databases developed in the first phase, the Active Program Research Requirements (APRR) project, but adds several important features. Seven heating systems and four cooling systems were evaluated, but only four of the heating systems and two of the cooling systems require additional research. The systems are ranked by a weighted combination of their potential displacement of nonrenewable energy, utilization of solar energy, and research costs at each of three conventional energy costs. In addition to the quantitative ranking of research options, the study indicates that advanced cooling systems could significantly reduce the national use of nonrenewable energy, but would have little effect on solar utilization. Heating systems offer a much larger opportunity for the utilization of solar energy. Of the heating technologies, large scale systems with seasonal storage have the greatest potential.

11072 **(DTH-LV—175) International Energy Agency solar heating and cooling program. Task VIII. Passive and hybrid solar low energy buildings. Performance data sources.** Moerck, O.; Holtz, M.J. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1986. 272p. NTIS (US Sales Only), PC A12/MF A01. File Number DE87750611.

This document presents the results of a survey of monitored passive and hybrid solar low energy residential buildings conducted within IEA countries during the period from autumn 1983 to spring 1985. The survey was undertaken as part of Subtask A, Performance Measurement and Analysis, of Task VIII, Passive and Hybrid Solar Low Energy Buildings of the IEA Solar Heating and Cooling Programme. One of the objectives of this Subtask is to report on the availability of data from monitored passive and hybrid solar low energy residential buildings in the member countries. The major part of the report consists of building description forms which briefly describe the buildings, summarize performance, list available data and identify reference sources for further information. More detailed performance data is provided for 60 of the buildings. To assist the reader in finding projects of particular interest, an indexing system has been generated, using 16 different entries from the forms.

11073 **(DTH-LV-R—85-8) Outdoor test houses at Thermal Insulation Laboratory, Technical University of Denmark.** Olsen, L. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jun 1985. 18p. (CONF-8006284—1). Danmarks Tekniske Hoejskole, Lab. for Varmeisolering, DK-2800 Lyngby, Denmark.

From Conference on development of passive solar test cell methodologies; Ispra, Italy (12 Jun 1980).

As part of the research at the Thermal Insulation Laboratory (TIL) a number of outdoor passive solar experiments have been undertaken. This paper reviews the objectives of the work, the construction features of the six test buildings and summarizes the measurement technique used in the tests.

11074 **(DTH-LV-R—85-16) BLAST - Calculation of temperature and energy consumption in Vesterbo.** Christensen, J.E. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Nov 1985. 68p. (In Danish). Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering.

The apartment building Vesterbo Langhus has been renovated by an attached glass building and a solar wall supplemented with ventilation systems and heat recovery. Furthermore the aspects of the building have been extra insulated. In order to analyse the energy savings that this renovation will result in and the temperatures that will occur in the glass building the building was analysed by the American energy calculation program BLAST. Only the net energy consumption for space heating was calculated. The results of the net energy consumption calculations are presented for the following renovating measures: attached glass building, 2 different ventilation systems with heat recovery, solar wall with or without selective coating, insulation of the northern aspects by 100 mm, insulation of both the northern and southern aspects by 100 mm. The net energy consumption for space heating before renovation is

5077 kWh/year. By insulation of the northern and southern aspects energy savings of 15,7% is obtained. Installation of a ventilation system with heat recovery combined with insulation results in energy savings of about 26,5%. By only using an attached glass building energy savings of 15,7% may be obtained. If the glass building is supplemented with a ventilation system including heat recovery the obtained energy savings will be up to 23,2%. By renovating with attached glass building, ventilation system/heat recovery, an unventilated solar wall with selective absorber surface, and an extra insulation of the northern aspect the total energy savings will be 31,9%. Also the temperature variations in the attached glass building with the two ventilation systems are calculated.

11075 **Solar system fault detection.** Farrington, R.B.; Pruett, J.C. Jr. (to Dept. of Energy, Washington, DC). US Patent 4,626,832. 2 Dec 1986. Filed date 14 May 1984. v.p.

This patent describes an apparatus for detecting predetermined faults in a variety of active, different solar systems. Each of the different solar systems uses a heat transfer fluid and has a tank for receiving fluid or a heat exchanger to transfer heat from the heat transfer fluid to a tank, and at least one collector and one pipe through which fluid flows. The different solar systems each has different predetermined operating conditions associated with a given type of fault, comprising: a. sensing means for sensing the presence of different predetermined operating conditions associated with each of the solar systems. Each of the sensing means includes a switch that changes in state in response to a change in a predetermined operating condition in at least one of the fluid, tank or heat exchanger, collector, and pipe; b. means in communication with each of the sensing means for determining whether one or more predetermined faults have occurred in one of the solar systems, the means for determining including combining means. The combining means includes logic gates at least one of which is actuated by logic gate actuating voltages via the associated states of at least two of the switches to produce an output signal indicative of whether a predetermined fault is present in the one solar system; and c. indicating means responsive to the output signal for indicating the presence and identity of the one predetermined fault in the one solar system.

11076 **Passive-solar directional-radiating cooling system.** Hull, J.R.; Schertz, W.W. (to Dept. of Energy, Washington, DC). US Patent 4,624,113. 25 Nov 1986. Filed date 27 Jun 1985. v.p.

This patent describes a cold-producing device comprising, an infrared radiating body including a radiating surface aimed at the sky and capable of emitting rays within one or more wavelength bands for which the atmosphere is transparent, a cover spaced apart from the radiating surface towards the sky and transparent to the one or more wavelength bands, the cover being thermally isolated from the radiating surface by a vacuum to reduce the formation of condensation on the cover when the radiating surface is a temperature below the dewpoint of the atmosphere, and a housing supporting the radiating body and cover, the housing including means for thermally coupling the radiating body to an ice-storage reservoir.

11077 **Evaporative cooling using thermal storage.** Peterson, J.L.; Hunn, B.D.; Hedstrom, J.L. (Center for Energy Studies, Univ. of Texas at Austin, Austin, TX 78758). *Passive Solar Journal;* **3**: No. 2, 125-148(1986).

The authors assessed the annual cooling energy savings resulting from nighttime evaporative cooling in a small [10,000 ft/sup 2/ (929m/sup 2/)] office building. They used an hour-by-hour computer simulation to compare the performance of structural mass cooling and evaporative cooling of a chilled water storage tank at night in 11 U.S. climate zones. They studied direct and combined direct/indirect evaporative cooling systems that were incorporated in a variable-air-volume heating, ventilating, and air-conditioning system. The results show that cooling energy savings relative to conventional vapor-compression cooling are obtained with evaporative system in all of the climate zones studied when thermal mass, preferably in the form of structural mass, is incorporated. The results also indicate that in two of the climate zones studied, conventional cooling can be eliminated entirely by including thermal mass in the evaporative cooling system.

11078 **Liquid convective diode retrofit of Bolling Air Force Base housing unit.** Scofield, S.H.; Maloney, T.; Jones, G.F. (Housing Facilities Branch, Hq. U.S. Air Force/ LEEH, Washington, DC 20330). pp 410-415 of Proceedings of the 11th national passive solar conference. Volume II. New York, NY; American Solar Energy Society (1986). (CONF-860655—).

From American Solar Energy Society annual meeting and 11. national passive solar conference; Boulder, CO, USA (8 Jun 1986).

This paper presents the state of the art development and evaluation of the recently completed liquid convective diode retrofit at Bolling Air Force Base. This evaluation represents the first residential (not laboratory) testing of the liquid convective diode. It is the result of coordinated efforts of the U.S. Air Force, Los Alamos Laboratory, and One Design Inc., to evaluate a seamless molded polyethylene siding component, which can be retrofit into wood framed walls. There has been a long tension between the low cost insulated wall and design for utilization of solar gain because of conflicting advantages and disadvantages. The liquid convective diode uniquely resolves this conflict by retaining the insulating envelope while passively collecting, storing and delivering heat energy. The liquid diode maintains the integrity of the building envelope insulation while providing significant solar gain, and appears to provide both in an aesthetically attractive fashion. The following are reported: (1) historical background; (2) project execution; (3) diode and house description; (4) monitoring methodology; (5) monitoring results; (6) conclusions; (7) future work.

11079 **Passive space heating with a self-pumping vapor system.** Hedstrom, J.C.; Neeper, D.A. (Los Alamos National Lab., Los Alamos, NM 87545). pp 493-498 of Proceedings of the 11th national passive solar conference. Volume II. New York, NY; American Solar Energy Society (1986). (CONF-860655—).

From American Solar Energy Society annual meeting and 11. national passive solar conference; Boulder, CO, USA (8 Jun 1986).

In this system, which should be useful for space or water heating, a refrigerant is evaporated in a solar collector and condensed within thermal storage located in the building below the collector. The vapor pressure generated in the collector periodically forces the condensed liquid upward to the location of the collector. This paper reports results of an operational test, in which this system provided passive space heating for an outdoor test cell during a winter season. The daily average energy yield and the elevation of collector temperature caused by self-pumping are reported, as well as observations on failure modes, system reliability, and suggestions for a practical configuration.

11080 **Testing of residential packaged space heating systems.** Carlisle, N.; Farrington, R.B. (Solar Energy Research Institute, Golden, CO 80401). pp 240-243 of Proceedings of ASES 86 annual meeting. New York, NY; American Solar Energy Society (1986). (CONF-860665—).

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

In this paper, the field performance of four active solar space conditioning systems, developed under the Residential Packaged Space Heating Systems Program, are reported. The objective of the program was to develop the laboratory prototype systems that draw on the results of current component research, system performance analysis and measurements, and advanced concepts developed during the last few years. The systems were monitored for one year by the National Solar Data Network (NSDN). The paper describes the systems, presents performance data, and compares the performance of these systems to others monitored by NSDN.

1410 Solar Collectors And Concentrators

11081 (DTH-LV-R—85-5) Efficiency testing of solar collector prepared for the energy research program of the Danish Ministry of Energy. Product: Thermal Insulation Laboratory. Oestergaard Jensen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Mar 1985. 25p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750614.

A detailed description is given of the collector, the testing method and the test stand. The result of the efficiency testing is presented as the expression: n = 0,76 - 3,9 (T/sub m/-T/sub 1/)/E - 0,008(T/sub m/-T/sub 1/)/sup 2//E, where n= efficiency, T/sub m/ = mean fluid temperature, T/sub 1/ = air temperature, E = irradiance. The conditions for the efficiency result are: Tilt 45 deg C, fluid flow rate 0.041 kg/s, 50% propylene glycol, wind speed 5 m/s.

11082 (DTH-LV-R—85-7) Test and calculation methods used in Denmark for solar collectors, heat storages and solar heating systems. Oestergaard Jensen, S.; Svendsen, S.Aa. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). May 1985. 21p. Danmarks Tekniske Hoejskole, Lab. for Varmeisolering, DK-2800 Lyngby, Denmark.

The aim of this report is to describe the Danish methods for testing solar collectors and heat storages and how the results from these tests establish a basis for simulation programmes used to calculate the performance of solar heating systems. The test methods and computer programme have been developed by the Thermal Insulation Laboratory partly based on our participation in various groups working on the subject within the European Community and the International Energy Agency. The method is now used for commercial systems by the Danish Solar Energy Testing Laboratory.

11083 (DTH-LV-R—85-17) Performance of uncovered solar collector. Svendsen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Sep 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750613.

Testing of efficiency or energy output of uncovered collectors of the fully wetted type was investigated. A model for the energy output of that type of collectors was set up based on the temperature of the absorber surface. In the model the following coefficients have to be inserted: the absorptance of the absorber, the emissivity of the absorber, the convective heat loss coefficient at different air velocities. In order to use the model the relation between the fluid temperature and the absorber temperature has to be known. The test procedure therefore consists of measurements of 1) the absorptance and the emissivity of the absorbers 2) the convective heat loss coefficient and its variation with the air velocity 3) the heat transfer coefficient between the absorber and the fluid. The two last quantities can be found from heat loss tests. For a typical uncovered collector the coefficients were measured and a comparison between the measured and the calculated energy output was performed both indoors with a solar simulator and outdoors. In general there was quite good agreement and the influence of the thermal radiation did not seem to be a problem. The major problem or difficulties are in measuring the convective heat loss coefficient and use it because the relation between the meteorological wind velocity and the air velocity at the absorber surface is not well known.

11084 (NP—7900411) Results of an outdoor and indoor pyranometer comparison. Ambrosetti, P.; Andersson, H.E.B.; Liedquist, L.; Froehlich, C.; Wehrli, C.; Talarek, H.D. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland); Statens Provningsanstalt, Stockholm (Sweden); Physikalisch-Meteorologisches Observatorium, Davos (Switzerland); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Apr 1986. 203p. NTIS (US Sales Only), PC A10. File Number DE87900411.

The performance of a representative number of pyranometers which are commonly being used for solar collector testing or similar applications was investigated. Experiments were conducted both indoors and outdoors. Laboratory investigations from different places were compared. The results allow an assessment to be made of the overall accuracy of global irradiance measurements associated with the comparison of thermal performance data in solar energy applications. Practical guidance is provided for the selection of pyranometers. The present laboratory measurement techniques for determining the directional response of pyranometers were shown to be characterized by great uncertainties. The day-long variability of the pyranometer performance during a typical calibration day was found to be most indicative of the instrument's quality.

11085 (VTT-TUTK—410) Luminescent solar concentrators. Nyman, C.; Gyllenberg, U.; Leppihalme, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 64p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750645.

This is the final report of the study of Luminescent Solar Concentrators (LSCs) initiated in 1983. Experimental and theoretical research upon those factors that limit device efficiency were performed. The Monte Carlo method was used in simulating the LSC performance to compare various LSCs and to study how the plate size, shape and dye concentration affect the efficiencies. The results of the simulation are published in a separate study. Various types of inorganic concentrators were made with different dye concentrations. Glasses were doped with Nd, Pr of Yb and with a combination of two dyes of three various concentration ratios. The physical processes related to absorption and luminescence were measured. Emphasis was on finding suitable materials and dye concentrations for LSCs. The efficiencies of inorganic LSCs are found to be low compared with those of organic ones, which is a consequence of the absorption of the glass and the low efficiency of the dye in a glass structure. The efficiency of the organic collector is 4% and that of the inorganic below 1%. The efficiency of the collector depends on the absorption efficiency and the radiation damages on the organic dyes. Inorganic dyes have a good absorption efficiency but the quantum efficiency is low. The development of new collector materials might lead to an increase in efficiency. Luminescent thin films on solar cells were shown to increase the ultraviolet response and the efficiencies of the cells.

1420 Heat Storage

REFER ALSO TO CITATION(S) 11077, 11082

11086 Application of heated thermistors to speed measurements in thermohaline solutions. Lents, C.E.; Incropera, F.P.; Viskanta, R. (Purdue Univ., West Lafayette, IN). *Solar Energy;* **36**: No. 2, 179-186(1986).

The potential which heated thermistors have for speed measurements in the mixed layers of a thermohaline solution has been considered. Probes of varying bead diameter have been developed, and it was found that problems related to probe directionality and recalibration could be reduced to acceptable levels by using a bead of 2.41 mm diameter. With such a probe speeds could be resolved to within an uncertainty of +/- 0.5 mm/s with a time constant of approximately 1 s. The probe was tested in a laboratory thermohaline solution for mixed layer conditions simulating those of a solar pond. Significant spatial and temporal speed fluctuations were measured in mixed layers driven by bottom heating and/or an imposed recirculating flow. Relative to the mean speed, fluctuations were most pronounced and spatially random in heated layers and least pronounced in mixed layers driven solely by the recirculating flow.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 11441

1501 Resource Status And Assessment

11087 (LA—10685-MS) Reconnaissance evaluation of Honduran geothermal sites. Eppler, D.; Fakundiny, R.; Ritchie, A. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 36p. (In English and Spanish). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003796.

Six geothermal spring sites were selected on the basis of preliminary investigations conducted in Honduras over the last decade and were evaluated in terms of their development potential. Of the six, the Platanares and San Ignacio sites have high base temperatures and high surface fluid discharge rates and appear to have the best potential for further development as sources of electrical power. A third site, Azacualpa, has a high enough base temperature and discharge rate to be considered as a back-up, but the logistical problems involved in geophysical surveys make it less attractive than the two primary sites. Of the remaining three sites, Pavana may be a source of direct-use heat for local agricultural processing. Sambo Creek and El Olivar have either severe logistical problems that would impede further investigation and development or base temperatures and flow rates that are too low to warrant detailed investigation at this time.

1502 Geology And Hydrology Of Geothermal Systems

11088 (LA—10784-MS) Catalog of known hot springs and thermal place names for Honduras. Finch, R.C. (Los Alamos National Lab., NM (USA)). Aug 1986. Contract W-7405-ENG-36. 14p. NTIS, PC A02. File Number DE87003811.

Thermal place names were compiled from all 1:50,000 topographic quadrangle maps for the Republic of Honduras as of July 1986, from other published maps, and from several sources of unpublished data. Known hot spring sites include those visited by Empresa Nacional de Energia Electrica (Honduras) geologists, sites visited by Los Alamos geologists in 1985, and other sites known to R.C. Finch. The number of known hot spring sites in Honduras with temperatures >30°C is 125. In addition, 56 thermal sites are suspected on the basis of thermal place names. The total number of geothermal sites, known and suspected, is 181.

1503 Geothermal Exploration And Exploration Technology

11089 Fiber optic temperature sensor for use in a geothermal well. Angel, S.M.; Pearson, R.K.; Hirschfeld, T.B.; Haugen, G.R. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94500). pp 673 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—). Contract W-7405-ENG-48.

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

The development of fiber optic sensors, or optrodes, in the past several years has led to a great advance in the area of remote detection and analysis. Optrodes have been developed that measure temperature, pH, and a wide variety of chemical species. This paper discusses the development of a temperature optrode designed to be used in very hostile environments, such as those encountered in a geothermal well. The optrode sensor material is made of an extremely insoluble ceramic host (e.g. synroc) into which rare earth ions have been doped. The applications of this device are discussed, as well as methods for increasing the sensitivity of the optrode measurements.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 11091

11090 (IRD—86/17) Comparison of three surface plant options for the conversion of geothermal energy from hot dry rocks. Abubaker, M.; Smith, I.K.; Heppenstall, T. (International Research and Development Co. Ltd., Newcastle upon Tyne (UK); UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Apr 1986. 102p. (ETSU-G—0134). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The case for a continuation of financial support for work concerned with the extraction of geothermal energy from Hot Dry Rocks required information on the costs and performance of possible surface plant installations. The three most promising candidates, the flash steam cycle, organic Rankine cycle and trilateral wet vapour cycle have been analysed on a self consistent basis to provide information on capital cost and electricity and district heat output over a range of possible well output conditions.

1506 Environmental Aspects And Waste Disposal

11091 (DOE/SF/16299—T1) Technical analyses in geothermal development: Quarterly project status report, September-November 30, 1986. (Meridian Corp., Falls Church, VA (USA)). Dec 1986. Contract AC03-86SF16299. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003434.

Progress is reported in the following research areas: (1) development of a decision-making model for geothermal sludge and solid waste disposal; (2) development of a framework for integrated economic analysis; (3) assessment of incremental royalty income; (4) technical and engineering analysis; ;and (5) impact of artificial intelligence/expert systems technology on geothermal well drilling costs. (ACR)

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 11090

11092 (DOE/ET/27244—T5-Vol.1) Honey Lake Hybrid Power Plant Project. Volume 1. Executive summary. (Morrison-Knudsen Co., Inc., Boise, ID (USA); International Engineering Co., Inc., San Francisco, CA (USA)). Mar 1982. Contract FG03-79ET27244. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002205.

A technical and economic feasibility study of the engineering aspects of a hybrid wood-fired geothermal electrical generating plant is presented. The proposed plant location is in Lassen County, California, near the Wendel Amedee Known Geothermal Resource Area. This power plant uses moderate temperature geothermal fluid to augment the heat supplied from a wood waste fired boiler. This report defines major plant systems for implementation into the plant conceptual design and provides sufficient design information for development of budgetary cost estimates. Emphasis is placed on incorporation of geothermal heat into the power generation process. Plant systems are designed and selected based on economic justification and on proven performance. The culminating economic analysis provides the financial information to establish the incentives for construction of the plant. The study concludes that geothermal energy and energy from wood can be combined in a power generating plant to yield attractive project economics.

11093 (LA—10862-T) A study of pumps for the Hot Dry Rock Geothermal Energy extraction experiment (LTFT [Long Term Flow Test]). Tatro, C.A. (Los Alamos National Lab., NM (USA)). Oct 1986. Contract W-7405-ENG-36. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003799.

A set of specifications for the hot dry rock (HDR) Phase II circulation pumping system is developed from a review of basic fluid pumping mechanics, a technical history of the HDR Phase I and Phase II pumping systems, a presentation of the results from

experiment 2067 (the Initial Closed-Loop Flow Test or ICFT), and consideration of available on-site electrical power limitations at the experiment site. For the Phase II energy extraction experiment (the Long Term Flow Test or LTFT) it is necessary to provide a continuous, low maintenance, and highly efficient pumping capability for a period of twelve months at variable flowrates up to 420 gpm and at surface injection pressures up to 5000 psi. The pumping system must successfully withstand attacks by corrosive and embrittling gases, erosive chemicals and suspended solids, and fluid pressure and temperature fluctuations. In light of presently available pumping hardware and electric power supply limitations, it is recommended that positive displacement multiplex plunger pumps, driven by variable speed control electric motors, be used to provide the necessary continuous surface injection pressures and flowrates for LTFT. The decision of whether to purchase the required circulation pumping hardware or to obtain contractor provided pumping services has not been made.

11094 **Vaporization at supercritical pressures and counterflow condensing of pure and mixed-hydrocarbon working fluids for geothermal power plants.** Bliem, C.J.; Demuth, O.J.; Mines, G.L.; Swank, W.D. (Idaho National Engineering Lab., Idaho Falls, ID 83415). pp 61-65 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting improved utilization of moderate temperature geothermal resources. Testing at the Heat Cycle Research Facility located at the DOE Geothermal Test Facility, East Mesa, California is presently being conducted to meet this objective. Current testing involves supercritical vaporization and counterflow in-tube condensing in an organic Rankine cycle. Results of the experiments are given for both pure and mixed-hydrocarbon working fluids. The heater and condenser behavior predicted by the Heat Transfer Research, Inc. computer codes used for correlation of the data was in excellent agreement with experimental results. A special series of tests, conducted with propane and up to approximately 40% isopentane concentration, indicated that a close approach to "integral" condensation was occurring in the vertically-oriented condenser.

1509 Geothermal Engineering

11095 **Use of an acoustic borehole televiewer to investigate casing corrosion in geothermal wells.** Carson, C.C.; Bauman, T. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). pp 11 of Proceedings of the technical symposium of Corrosion 86. Houston, TX; National Association of Corrosion Engineers (1986). (CONF-860304—). Contract AC04-76DP00789.

From Corrosion '86; Houston, TX, USA (17 Mar 1986).

Corrosion of well and surface equipment due to the presence of hot, corrosive brines is one of the major problems facing geothermal operators. For wellbore casing, this problem is complicated by the fact that in-place inspection is difficult at best. In an attempt to improve this situation, a prototype acoustic borehole televiewer designed to operate in geothermal wells was used to study the corrosion damage to casing in three commercial wells. The results of this experiment were promising. The televiewer returns helped to define areas of major corrosion damage and to indicate the extent of the damage. This paper briefly discusses the corrosion problem, describes the acoustic borehole televiewer, and then summarizes the results of the field test of the televiewer's capability for investigating corrosion.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 11090

11096 **(DOE/SF/15603—1) Geothermal enhancement of mineral processing in Nevada: Final report, April 25, 1985-June 30, 1986.** Flynn, T.; Trexler, D.T.; Hendrix, J.L. (Nevada Univ., Reno (USA). Div. of Earth Sciences). Nov 1986. Contract FG03-85SF15603. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003852.

This report reviews mineral recovery techniques practiced at active mines throughout Nevada and determines those that may be enhanced by the application of geothermal heat energy from a nearby resource. Of the thirty-two active precious metal mines identified, ten have hot water on or near the property and could potentially benefit. A second purpose was to collect ore samples and geothermal fluids, determine if they are compatible in the hydrometallurgical process, and carry out laboratory tests to determine the effects of heating on recovery rates. In addition, interfering or counterproductive factors were also identified. The laboratory work consisted of measuring the effects of thermally enhancing two hydrometallurgical processes; cyanide heap-leaching of gold and silver ores and bacterial leaching of sulfide rich gold ores. Thermally enhanced cyanide heap-leaching of gold and silver ores produced increases in extraction ranging from 8 to 20% for gold and 17 to 40% for silver. The temperature required for these increases is 35°C to 40°C, well within the range of available geothermal resources.

1520 Geothermal Data And Theory

11097 **(SAND—86-0538) Thermal stress fracturing of magma simulant materials.** Wemple, R.P.; Longcope, D.B. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003290.

Direct contact heat exchanger concepts for the extraction of energy from magma chambers are being studied as part of the DOE-funded Magma Energy Research Program at Sandia National Laboratories. These concepts require the solidification of molten material by a coolant circulated through a borehole drilled into the magma and subsequent fracture of the solid either as a natural consequence of thermal stress or by deliberate design (intentional flaws, high pressure, etc.). This report summarizes the results of several thermal stress fracturing experiments performed in the laboratory and compares the results with an analysis developed for use as a predictive tool. Information gained from this test series has been the basis for additional work now under way to simulate magma melt solidification processes.

11098 **(STEV-FVE—86-2) Chemistry of geothermal water when storing at high temperature.** Banck, A. (Statens Energiverk, Stockholm (Sweden)). Oct 1985. 43p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750625.

This report describes the chemical reactions which could cause problems for heat storage in the Campan sandstone, a rock deposit situated in SW Skaane at 700 m depth. The emphasis is put on precipitate reactions which may clog the heat-exchanger and aquifer. The properties of water from the Campanian sandstone (geothermal water) in Lund during heating up to 110 degrees C have been investigated. A pilot scale heat exchanger unit has been constructed and used for this purpose. In a closed system (hydrothermal bomb), two different geothermal waters from the Campanian sandstone have been used to study the reactions between formation sediment and hot geothermal water. The results from the experiments show that calcite precipitates during temperature increase and may cause clogging in heat exchangers etc. This calcite precipitation is prevented by acidifying the water to a pH that is in equilibrium with calcite at the higher temperature, in this case a pH reduction from 6.6 to 6.2 is required. Furthermore, it appears that the geothermal water is very sensitive to oxygen contamination. Supplied oxygen oxidizes iron (II) and iron oxides precipitate. Dissolution of silica is the main reaction which occur when hot geo-

thermal water is brought in contact with formation sediments. The obtained results from the experiments have been compared to a computer model (WATCH 2) and good agreement has been achieved.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

REFER ALSO TO CITATION(S) 11070

1608 Wave Energy Converters

11099 **(ETSU-WV—1570-P27) S.E.A. Clam. Vol. 3E. Technical appraisal.** (Kennedy and Donkin, Consulting Engineers, Woking, Surrey (UK); UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Rendel Palmer and Tritton, London (UK); Department of Energy, London (UK). Wave Energy Steering Committee). Jun 1983. vp. British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A detailed technical appraisal of the wave energy device known as a 'Celam' is presented by a team of Consultants. The scheme assessed is a 2 GW array based off the coast of Skye. The cost of energy from such an array is assessed both by the Consultants and by the development team and the discrepancies between the two discussed.

11100 **(NP—7750607) Wave energy atlas.** Nielsen, K. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Skibs- og Havteknik). Dec 1985. 34p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750607.

Based on observations and measurements the wave energy potential for the Danish seas has been calculated. The total yearly wave energy potential is calculated to be 21566 GWh. The most feasible sites for wave energy power plants are the North Sea, Kattegat, and the sea around the island Bornholm. In the North Sea a 200 km long power plant may be placed with a yearly power production of 17520 GWh. In Kattegat it may be feasible to place a 115 km long power plant with a yearly power production of 2820 GWh, and in the sea southwest of the island Bornholm a 50 km long power plant may produce 1226 GWh. 7 refs.

17 WIND ENERGY

11101 **(ETN—6-97775) National wind energy development program 1981-1984. Inventory of executed projects and results.** Beurskens, H.J.M. (Projectbeheerbureau Energieonderzoek, Utrecht (Netherlands)). Oct 1985. 243p. (In Dutch). NTIS, PC A11/MF A01.

An inventory of the Dutch wind energy development program was made in order to prepare the next phase of the program. Centralized wind energy production, decentralized wind energy production, and general supporting subjects are overviewed. The transfer of knowhow to users is discussed.

11102 **(REPT—4098-39-05) Evaluation of the national wind energy development program NOW-2, phase 1.** (Projectbeheerbureau Energieonderzoek, Utrecht (Netherlands)). Sep 1985. 73p. (In Dutch). (ETN—86-97774). NTIS, PC A04/MF A01.

The situation in the field of wind energy in the Netherlands is depicted for the years 1980 and 1985. Central wind energy production projects (horizontal-axis turbines, offshore applications, multiple wind turbines, system studies), decentralized wind energy production projects (testing projects, test facilities, development of small and medium turbines, autonomous wind-diesel system, feasibility studies, cost-effective wind turbine), and the investigation of the effects of tip vanes on turbines are presented. Opinions of representatives from involved sectors are given.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 12278

11103 **(RISO-R—535) Meteorology and Wind Energy Department annual progress report 1 January-31 December 1985.** Kristensen, L. (ed.). (Risoe National Lab., Roskilde (Denmark)). Aug 1986. 91p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87750602.

The research in the Department of Meteorology and Wind Energy is directed towards two major applications: wind energy and modelling air pollution dispersion. In order to maintain a high level of technical competence within these applications the department has carried out both theoretical and experimental basic studies in the field of meso- and micrometeorology. The subjects range from surface energy balance research of the general spatial and temporal structure of atmospheric turbulence, to wind engineering investigations of dynamic loads on buildings, bridges and other structures. Very important parts of the applied work are the testing and licensing of windmills for the Danish market and providing consultation services for Danish windmill manufacturers.

11104 **(SL—84913) Influence from local terrain obstacles on the energy production by wind turbines.** (Skibsteknisk Laboratorium, Lyngby (Denmark)). Nov 1984. 85p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750609.

This report contains results concerning the influence from local terrain ibstavles on the energy production by wind turbines. The studies were carried out in the boundary-layer wind tunnel at the Department of Wind Engineering, Danish Maritime Institute. Three different types of obstacles were modelled in the wind-tunnel: buildings, hedges and wind turbines. The models of the buildings and the hedges were made in the scale ratio of 1:100, and the models of the wind turbines were made in the scale of 1:400. The change in the power content of the flow caused by the models was studied in simulated boundary layersm which corresponded to full-scale boundary layers. The results achieved by the model tests can be used to estimate the annual energy production by a wind turbine which is erected near an obstacle. The report shows correction factors which can be used to modify the annual energy production which has been calculated for a free standing wind turbine. The energy production for a free standing wind turbine can be calculated by a method described in the Windatlas for Denmark. During the project there was established a method for model scale investigations of the power output from arrays of wind turbines. The method can be used to simulate the power output from arrays of wind turbines which are erected in a specific terrain.

1704 Economics

REFER ALSO TO CITATION(S) 11173

11105 **(ETN—6-97721) Prospects for small and marginal farmers in Trichy district (Tamil Nadu, India) to use water pumping windmills for irrigation.** Goedhart, P. (Technische Hogeschool Twente, Enschede (Netherlands)). May 1984. 136p. Issuing Activity.

The economic, technical, and agricultural aspects of equiping poor farmers in India with wind-powered pumps were analyzed. It is concluded that the prospects for a market for windmills among nontarget group farmers (especially big farmers with diesel pumps) are better than the prospects among the target group farmers. Continuation of the project might lead to an improvement of the situation for the richer farmers, which would in turn lead to a decline in the situation of the original target group of the project, the small and marginal farmers.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 11070, 11103, 11104

11106 **(EEV—85-05) Nibe measurement programme. Fatigue measurements.** Hansen, K.S.; Nielsen, P. (Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby). Apr 1985. 61p. (In Danish). NTIS (US Sales Only), PC A04. File Number DE87750600.

Results are presented of a fatigue registration and service life determination for the two Nibe windmills. The measurements were carried out in the period 1982-1983. Based on the obtained results the maximum potential energy production was calculated for each of the two mill constructions which existed in 1982-1983. The calculation of the energy production was made by limiting the interval between the cut-in and cut-out wind speed to its optimum value. EFP. 15 refs.

11107 (ETSU-N—1-86, pp 117-148) **Aerodynamics control of wind turbines.** Graham, J.M.R. Feb 1986. BLDSC, Boston Spa, Wetherby, West Yorks. (CONF-8602107—).

From BWEA/DEN workshop on aerodynamics and control of wind turbines; Harwell, Oxon, UK (25 Feb 1986).

A paper presented at the British Wind Energy Association's 7th annual workshop discusses the possibilities for aerodynamic control of wind turbines. The fact that many methods of aerodynamic control of the lift and drag of aerofoils have been developed for the requirements and operating envelopes of aircraft wings which are different from those for wind turbine blades, is important in assessing the effectiveness of possible control devices. Four main aspects are discussed: 1) passive control determined by the blade characteristic including post-stall behaviour; 2) full or part-span pitch control of the blade; 3) control by deployment of flaps and spoilers; and 4) boundary layer and circulation control, principally by suction or blowing. Details of the discussion which followed the paper are given.

11108 (ETSU-N—1-86, pp 9-44) **Aerodynamic control aspects of HAWTG design.** Ketley, G.R.; Quarton, D.C. Feb 1986. BLDSC, Boston Spa, Wetherby, West Yorks. (CONF-8602107—).

From BWEA/DEN workshop on aerodynamics and control of wind turbines; Harwell, Oxon, UK (25 Feb 1986).

Four principal, technical requirements for controlling blade aerodynamics with horizontal axis wind turbines are described. These are 1) limiting the power developed at high windspeed, 2) stopping the machine in both routine and emergency situations, 3) governing the rotor rpm off-line for synchronization and 4) facilitating start-up of the machine. However, the main criterion for judging different control concepts is the final cost of the energy produced.

11109 (ETSU-N—1-86, pp 45-72) **Survey of aerodynamic control methods for vertical axis wind turbines.** Sharpe, D.J. Feb 1986. BLDSC, Boston Spa, Wetherby, West Yorks. (CONF-8602107—).

From BWEA/DEN workshop on aerodynamics and control of wind turbines; Harwell, Oxon, UK (25 Feb 1986).

After establishing the three principal purposes of aerodynamic control for vertical axis wind turbines, three types of control device are described. The categories are those which involve changing the geometry by moving the blades, those which use control surfaces and those which rely on the basic aerodynamic shape. Examples of each category are discussed.

11110 (ETSU-N—1-86, pp 73-90) **Changes in aerofoil characteristics due to radial flow on rotating blades.** Milborrow, D.J. Feb 1986. BLDSC, Boston Spa, Wetherby, West Yorks. (CONF-8602107—).

From BWEA/DEN workshop on aerodynamics and control of wind turbines; Harwell, Oxon, UK (25 Feb 1986).

Several wind turbine operators have recently reported experimental measurements of power and thrust which are higher than theoretical predictions in strong winds. One possible reason for these discrepancies is that aerofoil lift is higher than anticipated in the post-stall region due to the existence of spanwise flow components. Flow visualisation studies on fans support this hypothesis. A paper presented at the British Wind Energy Association's 7th annual workshop gives a critical evaluation of experimental data from a number of sources, both model and full scale, and clear indications of high post-stall lift. The mechanisms responsible for the phenomenon are discussed and a theoretical basis for the existence of radial flow developed. This appears to provide a basis for explaining the experimental measurements of radial outflow and high lift. Details of the discussion which followed the paper are given.

11111 (ETSU-N—1-86, pp 91-115) **Development of stall on horizontal axis rotors.** Hales, R.L. Feb 1986. BLDSC, Boston Spa, Wetherby, West Yorks. (CONF-8602107—).

From BWEA/DEN workshop on aerodynamics and control of wind turbines; Harwell, Oxon, UK (25 Feb 1986).

Some problems associated with the aerodynamics of wind turbines are briefly reviewed. Experimental measurements are presented for various performance parameters as a function of wind speed and compared with theoretical calculations.

11112 (ETSU-N—1-86, pp 149-157) **General discussion.** Feb 1986. British Library, Boston Spa, Wetherby, West Yorks. (CONF-8602107—).

From BWEA/DEN workshop on aerodynamics and control of wind turbines; Harwell, Oxon, UK (25 Feb 1986).

Details are presented of the general discussion which followed the one day workshop organized by the Department of Energy and the BWEA in February 1986 on the aerodynamics and control of both vertical and horizontal axis wind turbines. There were twelve participants in the discussion which included aspects such as wind tunnel measurements, in field measurements, tip spoilers and aileron control.

11113 **(N—86-32888) Attempt to evaluate the tip vane concept with a lifting-line model.** Devries, O. (National Aerospace Lab., Amsterdam (Netherlands)). Sep 1985. 25p. (NLR-MP—85071-U; B—8664364; ETN—86-97684). NTIS, PC A02/MF A01.

A nonlinear vortex model based on a lifting-line approximation (code HELIX) was developed to estimate the aerodynamic performance of the tip vane wind turbine. Application of the code reveals a strong dependence of the performance on the tip-speed ratio lambda. Though a power coefficient Cp-1 can be obtained for lambda between 3 and 4, the power is scarcely in excess of that of a conventional turbine (Cp between 0.40 and 0.45) for lambda between 10 and 11. The costs of rotor, gear box, and tower increase so strongly at low lambda, that the cost effectiveness of a tip vane wind turbine is only slightly better than for a conventional high lambda wind turbine. The perspectives of the tip vane concept are therefore more limited than originally expected.

11114 **(NP—7750601) Report on development of wood wings for Aerowatt windmills.** (Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark)). Jun 1984. 17p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750601.

The wooden wings are used on French Aerowatt mills that generate power for telecommunication equipment in Greenland. The wings could, however, not stand up to the arctic storms, and they broke. Therefore som load tests of wings of different sorts of wood have been carried out. The following experiments were performed: 1) Boards of different woods with the same thickness were made. These boards were then loaded with sandbags until breaking, if possible. The deflection related to the load is presented. 2) Boards of different woods with increased thickness at the root were made. The increased thickness decreases until the middle of the wing, and the rest has the same thickness. These boards were loaded until braking, if possible. The deflection related to the load is presented. 3) Load experiments were performed on the wing that was sent from Greenland Technical Organization. The deflection related to the load is presented. 4) Load experiments were performed on 2 wings made of Kerto and pine, respectively. The wings were loaded until breaking.

11115 (RISO-M—2547) Measurements of performance of a rotor with 8-m wind turbine blades from Micon Airfoil Technology. Friis Pedersen, T. (Risoe National Lab., Roskilde (Denmark)). Jul 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750596.

The report describes power curve measurements on a Micon 55-kW wind turbine with 8-m blades from Micon Airfoil Technology. Measurements were made of the electrical power output from which the annual energy production was calculated. On the basis of a measured transmission efficiency curve, the mechanical power and efficiency are also calculated.

11116 (THD-IW—R505) Rotor aerodynamics of horizontal axis wind turbines. Summary of lectures and discussions. Presentation of results of calculation methods. Vanbussel, G.J.W.; Vankuik, G.A.M. (Technische Hogeschool Delft (Netherlands)). Sep 1985. 39p. (In Dutch). (THE-R—738-D; ETN—86-97706). NTIS, PC A03/MF A01.

From Rotor aerodynamics of horizontal axis wind turbines. Summary of lectures and discussions. Presentation of results of calculation methods; Delft, Netherlands (4 Apr 1985).

Models for the calculation of the aerodynamic performances of horizontal-axis wind turbines under uniform straight flow were evaluated. The axial momentum theory was revised. The blade-element momentum method PHATAS and its Viterna-Corrigan correction are presented. The lifting line methods PREDICHAT and HELIX are explained. The results of the calculation methods for a reference rotor configuration were compared with measurements. Large discrepancies between the methods are found. Theory and experiment differ too much to allow a reliable prediction of the performance of designs. The measurements were not good enough for a correct evaluation of the theoretical models. The very large deviations of the results of PHATAS compared to other methods cannot be explained.

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11117 (EPRI-EL—4920-CCM) The HARMFLO code: Version 4.0: User's guide. Heydt, G.T.; Grady, W.M. (Purdue Univ., Lafayette, IN (USA). Dept. of Electrical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 147p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920163.

This sophisticated version of the HARMFLO computer code will allow utilities to study the effects of nonlinear loads on power systems more quickly and accurately than before. Code enhancements include models of induction motors and a feature that accelerates code execution. The work also produced a version of the code for IBM PCs.

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11118 (DOE/FC/10627—2228) Surface adhesion of low-rank coal ash: Quarterly report, January 1986-March 1986. Austin, L.G.; Benson, S.; Conn, R. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Aug 1986. Contract AC21-85FC10627. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003705.

The percent of ion-exchangeable cations was determined for the San Miguel lignite. The ion-exchanged material was produced by treating the lignite with ammonium acetate solution. The amounts of exchangeable sodium and calcium were found to be 98% and 76%, respectively. The adhesive properties of lignite ash and sub-bituminous ashes were evaluated using the sticking apparatus. ASTM ashes of these coals were suspended on platinum wire and heated in a methane-oxygen flame of adiabatic temperature between 1650° and 1750°C. The resultant molten slags were then dropped onto oxidized mild steel and stainless steel surfaces with typical compositions and temperatures corresponding to boiler tubes. The San Miguel and Navajo ashes each formed highly viscous, porous slags which did not wet the steel substrates. Slag viscosity of the low-rank coal ashes may be more important for judging ash sticking tendencies than ASTM ash fusion temperatures. The ash viscosity predicted by empirical composition/viscosity correlations for the tested slags varied by one to two orders of magnitude from ash to ash whereas the ash fusion temperatures were fairly similar. A vertical tube furnace was used to grow deposits using combusted raw and ion-exchanged San Miguel lignite on cooled boiler steel substrates at conditions similar to those in a utility boiler. Strengths of the deposits were measured and correlated with deposit height and temperature. X-ray diffraction analysis was used to determine the crystalline phases present in bulk deposits.

11119 (EPRI-CS—4252-Vol.3) Dissimilar-weld failure analysis and development program: Volume 3, Accelerated discriminatory tests: Final report. Prager, M. (Metal Properties Council, Inc., New York (USA)). Nov 1986. 240p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920105.

This volume of the report on research project RP1874 describes the results of studies to develop an accelerated discriminatory test for evaluation of dissimilar metal welds (DMWs) typical of those found in boiler superheater and reheater tubing. The weldments of interest are generally those between 2-1/4 Cr - 1 Mo low-alloy steel and 300-series stainless steel, including those made by the induction-pressure-welding process, those made with austenitic stainless-steel filler metal, and those made with nickel-base filler metal. The overall objective of the testing was to reproduce, in the laboratory, the types of failure observed in this class of weldments in fossil boiler service. The failures generally occur in the low-alloy steel immediately adjacent to, or along, the weld fusion line. Characteristically, failure is by relatively low-ductility cracking that exhibits characteristics suggesting that creep plays a dominant role in the failure process. As a result of the test program, two types of discriminatory tests were developed. One applies relatively small loads to DMWs made with annealed 2-1/4 Cr - 1 Mo with or without preaging. The other applies relatively high loads to DMWs made with normalized and tempered 2-1/4 Cr - 1 Mo and not preaged. Both test types produce service-like failures and indicate relative performances consistent with service observations. 45 refs., 181 figs., 29 tabs.

11120 (EPRI-CS—4723, pp 1.3-1.8) Cycling of fossil plants: the key issue of the next 10 years. Armor, A.F. (Electric Power Research Institute, Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

It is clear that utility industry interest in plant cycling is widespread. The discussions, papers and workshops of the Conference are structured to transfer available technology to member utilities, focussed solely on the needs of fossil plants converted from baseload to cycling duty. This permits individual utilities to assess what modifications might help their individual units, leading to improved performance for the utility industry as a whole.

11121 (EPRI-CS—4723, pp 1.11-1.23) Strategies for fossil plant cycling. Wong, F.K.L. (Electric Power Research Institute, Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Slow load growth in the electric utility industry is now accepted as standard; for example, in the last decade load growth has averaged below 3% per year. In that same period, major changes have taken place in the nation's overall industry that alter the traditional way the utility industry operates. Events that have affected the electric utility load growth include the fuel oil crisis that led to economic recession in the 1970s, the emergence of technologies which have improved the efficiency of end use, and the dramatic shift of the overall industry from the manufacturing to the service sector. The difference between the 7% load growth which was widely expected in the early 1970s and the actual growth rate is

shown. Many utilities that committed generating units in the 1970s now encounter high reserve margins. In order to optimize system generating costs, nuclear power, which has a relatively low operating fuel cost, carries a high proportion of the baseload. The fossil units, which have typically been designed for baseload operation, now cycle in order to accommodate the daily load swings. As the peak demand must still be met, the off-peak cycling demand creates equipment availability problems that require solutions. The cycling conversion and operation strategies for baseloaded unit are discussed. Utility approaches to plant modifications for cycling operation are emphasized.

11122 (EPRI-CS—4723, pp 2.3-2.30) **Cycling duty experience in the United States.** Fruchtman, I.; Handy, B.; Wong, F. (Ebasco Services Inc., New York, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Cycling duty has long been part of many electric utilities' operating regimen. This cycling experience is an important body of information and particularly useful now for other utilities planning to convert a base-load-design power plant to cycling duty. As part of its program to assist the industry implementing reliable and economic cycling duty conversion, EPRI surveyed utilities who regularly cycle some of their units. A major objective was to identify significant modifications to plant equipment and operation which allowed reliable cycling duty. A second objective was to learn methods for improved cycling-unit productivity. Here it was wished to determine how fuel and maintenance costs are controlled, and considerations for monitoring of component vibration, water chemistry, and other performance indicators. A third objective of this study was to determine utility needs associated with cycling operation, where EPRI research and development efforts are needed. Some key findings of this study are presented.

11123 (EPRI-CS—4723, pp 2.59-2.72) **Startup advisor for fossil fired power plants.** Dixon, R.R. (Babcock & Wilcox, Lynchburg, VA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

There are many alternative methods of cycling fossil power plants. Some are better than others. All are complex compromises designed to achieve a set of operation objectives for each specific plant. The boiler and turbine vendors have analyzed their equipment and developed recommended operating procedures which they believe provide the type of service desired while avoiding excessive life expenditure. In all cases, a major problem with cycling involves the excessive life expenditure of critical components during low load or re-start operation. Despite the vendor's efforts, many questions about various operating modes remain unanswered or obscure. In an attempt to alleviate this problem, EPRI initiated several projects designed to provide either missing information or the analytical tools needed to aid in deciding how to operate a specific plant. The conclusions of the studies were that although the projects produced accurate and useful information, the results were not widely used directly or at least were not accredited to EPRI efforts. Those projects that produced tangible output other than a report, and involved utilities directly during the course of the project, such as MMS, had far more industry use and EPRI visibility. The findings of the study provided the motivation for this project.

11124 (EPRI-CS—4723, pp 2.75-2.109) **Dynamic modeling and performance evaluation of a fossil-fired power plant during full-load and reduced-load operations.** Lin, C.S.; Hashemi, A.; Wong, F.; Barcelo, W.R.; Sanders, C.W. (Science Applications International Corp., Hermosa Beach, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

A dynamic performance model of a standard fossil-fired power plant for low-load operation is presented. The model contains major components in a fossil plant including pulverizer, drum boiler, superheaters, reheaters, economizer, attemperators, pumps valves, piping, condenser, turbines, deaerator and low/high-pressure feedwater heaters. The EPRI modular modeling system (MMS) and Boeing Computer Services' engineering analysis system 5 (EASY5) simulation language were used in the simulation. A control system model was also developed to simulate the plant control system and perform the necessary control functions. Simulation calculations were carried out for a standard coal-fired power plant of the Middle South Utilities System (MSUS) during steady-state and transient modes of operation. The results were obtained for full load and reduced loads down to 35%. Presented are the time histories of selected system variables such as pressure, steam temperature, steam flow rate, water level and damper position. The steady-state system performance parameters, such as heat absorption rates in various components, pressure and temperature profiles in the boiler, as well as plant heat rates, are calculated. The effects of (1) different modes of operation-sliding pressure versus constant pressure, (2) variations of ramp rate, (3) possible flow reversals in the turbine extraction lines, and (4) control system damping behavior during transition from full load down to reduced loads were also studied.

11125 (EPRI-CS—4723, pp 2.113-2.125) **Plant cycling effects on environmental control equipment.** Cichanowicz, J.E.; Blake, J.H. (Electric Power Research Institute, Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The electric utility industry has become greatly concerned over the last few years about cycling of fossil-fueled power generating plants. These concerns arose from two causes. First is the rapid escalation in fuel prices which has forced utility systems to increase capacity factors on their more efficient units and cycle the others in order to minimize generation costs. The second cause is that many of the plants now required to cycle were not designed to do so efficiently or without detrimental effects to the equipment. Two EPRI projects address the problems that cycling loads impose on the environmental control equipment. The first is a recently completed scoping study, RP 1184-6, that identified cycling related issues and recommended subjects that merit further R and D work. The second project, RP 1184-16, just beginning, will determine the most cost effective modifications needed to convert a specific large coal-fired, base loaded unit to cycling duty. This second project will actually consider the whole unit: boiler, turbine-generator, balance of plant, and the environmental controls. The part of this project that pertains to the environmental controls is briefly reviewed.

11126 (EPRI-CS—4723, pp 3.3-3.22) **Options for cyclic operation of a base-load design generating unit.** Biernesser, G.J.; Dittrich, R.F.; Hynds, J.A.; Solowski, S.J. (Public Service Electric and Gas Co., Newark, NJ). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Public Service Electric and Gas Company (PSE & G) is the third largest combined electric and gas utility in the US. The electric system supplies energy to more than 1.7 million customers in a 1400 square mile, highly industrialized, and densely populated corridor between the cities of Philadelphia and New York. The load is comprised of a balanced mixture of residential, commercial, and industrial customers. PSE & G is a member of the Pennsylvania-New Jersey-Maryland (PJM) Interconnection, which integrates the bulk power generation and transmission operations of eleven utility systems. PJM is dispatched as a single system, using the most economical mix of generating units available to the interconnection, to meet the combined loads of all member companies. The 1984 load and capacity situation for PSE & G and PJM are given. The PSE & G peak load was 7422 MW in 1984, when the Company produced 34.2 million MW-hrs of energy. The PSE & G load factor was 52%, as compared to 60% for PJM and the national average of 62%. It is shown that, with all units available, the minimum capac-

ity exceeds the minimum load by approximately 35% for both PSE & G and PJM. This minimum capacity is equal to the full output of the nuclear units plus the normal minimum output of the must-run fossil units. The increase in minimum load generation which will occur as new units are brought on-line during the next few years is shown. Some options for the cyclic operation of a base-load design generating unit are discussed.

11127 (EPRI-CS—4723, pp 3.23-3.51) **Operating experience with cycling large coal fired electric utility generating units.** Moore, C.T.; Bodach, P.; Sidey, D. (Ontario Hydro, Toronto). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The testing and modifications performed and planned by Ontario Hydro to prepare eight 500 megawatt turbine generator units at Nanticoke fossil-fired generating station for two-shifting duty are discussed. Test data are presented and operation changes are explained. Equipment and control system modifications, including reorganization and upgrading of boiler drains, are described. By the end of 1985, five units will have been released for two-shifting duty with a modification cost of $25,000 (CAN) per unit. The remaining three will be released in 1986. Further modifications at significantly higher cost will be phased in over the next several years after careful justification on a financial evaluation basis.

11128 (EPRI-CS—4723, pp 3.53-3.71) **Cycling modifications to a base loaded unit.** Rogers, T.M. (Duke Power Co., Charlotte, NC). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

With the addition of base loaded nuclear generation to the Duke Power Company System, the larger previously base loaded fossil units have had to assume more of a load following mode of operation. In 1987, when Catawba 2 Nuclear Station becomes commercially available, approximately 50% of the system will be base loaded nuclear generation. During periods of low system load demand, the larger fossil units will be required to either attain sufficiently low loads or be cycled on and off daily to meet system dispatch requirements. The load situation projected for 1988 is shown. Most of the larger fossil units were designed for base load operation. To determine the feasibility of cycling these units, a study was performed utilizing the appropriate vendors to examine potential equipment and operational problems. Results of the study are presented.

11129 (EPRI-CS—4723, pp 3.73-3.82) **Cycling experience of Units 4, 5, and 6 at the Mystic Station of Boston Edison Company.** Creed, J.E.; Woods, J.C.; Hetherington, D.L.; Ayvazian, J.L. (Boston Edison Co., MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

With the advent of more new generating units coming on-line, many electric utilities have been faced with the realization that their older and less efficient units are destined to provide limited if not sporadic power generation to the electric transmissions and distribution systems. Boston Edison Company, Mystic Station Units #4-5-6, averaging 26 years of service, are the least efficient of the Company's steam generating plants that have, through necessity, been relegated to a cycling mode of operation. The experiences with coordinating the dispatch of old and new units with specific emphasis on the cycling of Mystic #4-5-6 are described. A chronological approach has been taken in the presentation of facts that incorporate not only the operating experiences but also efforts made to modernize and maintain the power plant equipment necessary to produce the reliable and efficient power generation required by the electric transmission and distribution system. The recent forecasted growth in demand places special emphasis on the continued use of older units as an alternative to new generation. Programs have been implemented to address life extension and to improve availability and heat rate for the existing units.

11130 (EPRI-CS—4723, pp 4.43-4.73) **Adaptation of FECSA power plants to medium and peak load operation.** Veiga, E.; Kral, R. (FECSA, Barcelona, Spain). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The structure of electricity production in Spain has changed a great deal during the past five years as a consequence of the diverging price trends for different fuels. In Spain, as in other European countries, the increasing number of nuclear power plants, which, on account of their profitability, generate the base load, have caused fossil fuel plants to be relegated to a sphere of lesser use. For many of the existing power plants this means adaptation of the base load operation to medium and peak load operation, with participation in the secondary regulation of the network. The variation in the production structure of FECSA, one of the largest Spanish power utilities, whose sphere of activity is Catalonia is shown. In view of the greater quantity of electricity being supplied by nuclear plants, it became necessary to convert the fossil-fueled power plants to medium and peak load operation. These plants, built between 1965 and 1975, were converted by FECSA and the manufacturers in order to adapt them to the new requirements.

11131 (EPRI-CS—4723, pp 4.75-4.97) **IHI's experience in cycling operation of new and retrofit boilers.** Ando, S.; Otsubo, T. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

In recent years, the demand for thermal power plants in Japan with cycling operational capability has increased, due to an increase in peak demand for electric power. Utilities with oil-fired boilers, both natural circulation and variable pressure once-through units, are requesting that these boilers have the capability to operate in cycling service. From September 1982 to January 1983, IHI, the licensee of Foster Wheeler Energy Corporation, delivered three oil-fired natural circulation boilers (each 375 MW) designed for cycling service for Aioi Thermal Power Station Nos. 1, 2 and 3 units of Kansai Electric Power Co. These boilers have been successfully operated in cycling service. The design features of both newly installed and retrofitted boilers for cycling service and actual operating results are described.

11132 (EPRI-CS—4723, pp 4.119-4.131) **Exploitation, maintenance, and decommissioning of fossil fire units in France.** Uselle, C. (E.D.F. Power Plant of Cordemais, St. Etienne De Montluc, France). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Since 1983, EDF had realized that the use of old or new fossil fired plants would probably be reduced in the future because of the development of nuclear generation and the increase of the demand of electricity. In spite of the reduction of nuclear program, in March of the same year, the board of Directors of EDF agreed to a program of decommissioning of fossil fired units. The decommissioning program, decided in March 1983 and based on the assumption of a home consumption of electricity of about 390 TWh in 1990, is described.

11133 (EPRI-CS—4723, pp 2.31-2.55) **Corrosion product transport in a cycling fossil plant.** Hook, T.A.; Pearle, W.L.; Sawochka, S.G.; Scheibel, J.; Pugsley, J. (NWT Corp., San Jose, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The objectives of EPRI RP1184-9 are to determine the effect of major chemistry parameters (pH, hydrazine and oxygen) and operating procedures on corrosion and corrosion product transport in cyclic high pressure fossil boilers and to recommend meth-

ods that will reduce corrosion product transport thus leading to increased availability of these units. A series of tests was conducted at the Port Everglades Station of Florida Power and Light (FP & L) to quantify the effect of chemistry and operational changes on corrosion product transport during cyclic operation. The results of the first tests performed in November 1984 were reported in June at an EPRI Symposium on Fossil Plant Water Chemistry. Results from tests in January 1985 and July 1985 are presented.

11134 (EPRI-CS—4723, pp 4.1-4.19) **Cycling capability of supercritical turbines: a world wide assessment.** Armor, A.F.; Hottenstine, R.D. (Electric Power Research Institute, Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The limitations of present day supercritical turbines are discussed in terms of suitability for cycling duty. In the US, operating supercritical turbines are particularly unsuited to two-shift operation although this is a desirable feature for some utilities. Japanese and European designs, on the other hand, are shown to have some features which enhance such duty and which stem from an early need in these countries for flexible, mid-range operation. Future US supercritical units may benefit from such features as fast automatic start-up systems, spiral wound variable pressure boilers, turbine bypass systems, full-arc admission and integrated turbine and boiler on-line stress analyzers. A major objective during cycling operation is the mitigation of hard particle erosion of turbine components.

11135 (EPRI-CS—4723, pp 4.21-4.42) **Cycling effects on boiler feed pumps.** Simon, A.; Eichhorn, G.; Vach, R.; Pace, S. (Sulzer Brothers, Ltd., Winterthur, Switzerland). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

In recent years cycling operation of power stations has become a standard requirement of the utility industry. As a consequence of this development, the suitability of every component in the power generating train must be carefully reassessed in great detail against the operational requirements it faces. In the case of the boiler feed pumps such operational requirements essentially consist of: boiler load reduction at a rapid rate (e.g., 0.75%/s) down to about 25% load; boiler load reduction following a turbine trip (e.g., 1% load drop/s) with pumps on hot standby; and boiler load increase with pumps on standby (e.g., pump start-up from cold standby). These problems occur because of changing boundary conditions around the pumps (deaerator/feedwater tank, suction pipe, operating transients, etc.). The plant boundary condition for pump operation is discussed.

11136 (EPRI-CS—4723, pp 4.99-4.117) **Flame monitoring: an aid to boiler cycling.** Jones, R.M. (McGinnes/Royce Ltd., Camberley, England). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The role of the flame monitor on large fossil fuel boilers has traditionally been one of safety. The need to prevent unburnt fuel entering the combustion chamber in the event of a loss of flame to prevent possible explosions has been the overriding requirement of most legislators and boiler operators. While a certain degree of success has been achieved on fuel oil and gas flames, considerable problems existed with monitoring techniques for pulverized coal combustion. On all fuels, there are many pitfalls likely to interfere with the continuous operation of plant and the overall unreliability of flame monitoring has led to distrust of the equipment. In many instances, flame monitors are not installed or, where installed are either not in operation or bypassed at critical periods of operation. Two flame monitoring developments are described which are designed to monitor all fuels, particularly pulverized coal, and which not only provide a high degree of confidence in terms of protection but are beginning to provide sensible data on the quality of the combustion being monitored. Rapid load changes on boilers, cycling, two shifting or load following has placed an extra burden on the boiler operator and the flame monitors. It is believed that the systems described offer a reasonable opportunity to monitor these changes and allow the most economic operation of the equipment at all times.

11137 (EPRI-CS—4723, pp 5.1-5.19) **Design considerations for the cycling conversion of a once-through steam generator.** Fitzgerald, F.D. (Foster Wheeler Energy Corp., Livingston, NJ). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Foster Wheeler has completed the design and fabrication of boiler modifications required for the low-load cycling conversion of the Southern California Edison (SCE) Ormond Beach Station No. 2 steam generator. The unit is an 80 MWg, oil and gas fired, once-through supercritical steam generator, originally designed for base load service. After the installation of the designed modifications (March, 1986), the steam generator is scheduled to be routinely cycled, with contract performance warranties relevant to loads as low as 6% turbine load. Those engineering alternatives and design criteria encountered in the course of this retrofit are discussed.

11138 (EPRI-CS—4723, pp 5.21-5.36) **Drum boiler components cycling effects and solutions.** Rudd, A.H. (Babcock & Wilcox, Barberton, OH). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Currently operating boilers, even from the same manufacturer, exist in a wide variety of sizes, configurations, and details of construction. This variety results from a number of influences at the time of design. Sizes, or capacities, have increased over the years as utility systems have increased in size. From either design necessity or economic pressures, the size changes have dictated different configurations and details of construction. Because of the wide variety of designs in service, boilers cannot usually be considered generically for the effects of cycling. Instead, it is more meaningful to look at certain components of the boilers that are identified by experience and design analysis as being most vulnerable to cycling service. These are discussed from two standpoints: operating methods to minimize cyclic damage, and design modifications to increase tolerance to cyclic conditions. This discussion considers only pressure part components of the boiler. Non-pressure parts, such as casing, vestibules, windboxes, flues and ducts, are greatly affected by cycling service. However, their failure (leaks) is more tolerable than failure of pressure parts.

11139 (EPRI-CS—4723, pp 5.37-5.63) **Boiler stress and condition analyzer.** Dunn, K.M.; Scheibel, J.R.; Schwarz, E. (Combustion Engineering, Inc., Windsor, CT). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Life extension of steam generators has become an issue of major importance to the electric utility industry. Many electric utilities currently have boilers in service that are 30 years old and older. When these units were designed and built it was commonly assumed that they would be displaced by newer equipment within 30 to 40 years because of technological improvements providing greater capacities, higher efficiencies and better reliability. For steam generators that are 25 to 30 years old, components such as thick-walled pressure parts, which historically have been trouble-free, have become an area of concern. In fossil-fired units producing high-temperature steam (900° F or more), these components exhibit the effects of several aging mechanisms: erosion, corrosion (both internal and external), and cracking phenomena such as fatigue, stress-rupture, corrosion-fatigue and creep-fatigue interactions. EPRI has initiated several projects to develop the technology required to support life extension related activities. As part of an EPRI project, a Boiler Stress and Condition Analyzer (BSCA) system has been installed at the Consolidated Edison Ravenswood #30 plant, a 1000 MW twin-boiler divided furnace oil-fired unit.

The BSCA system is described, the parameters which determine the configuration of the system are outlined, and representative data from the Ravenswood system are presented and used to describe the real-time analysis of the system.

11140 (EPRI-CS—4723, pp 5.65-5.88) **Design and operation of air pollution control equipment for cycling units.** Rymarczyk, W.J.; Katzberger, S.M. (Sargent & Lundy, Chicago, IL). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Utilities have expressed an increased interest in cycling operation for new coal-fired units in recent years. Cycling operation may be categorized as (1) two-shift cycling - where the unit is shut down every night, (2) weekend cycling - where the unit operates around the clock on weekdays but is shut down on weekends, and (3) extended shutdown cycling - where the unit is shut down for prolonged periods of time. Cycling units may also be subject to sudden load changes and may be operated frequently at low load. Typical load patterns for cycling units are shown. Cycling can present specific problems that should be considered in the design of electrostatic precipitators, baghouses, and flue gas desulfurization (FGD) systems. Operating procedures for pollution control equipment at cycling units also require special attention. These problems and operational procedures are discussed.

11141 (EPRI-CS—4723, pp 6.1-6.23) **Update on partial-arc admission turbines for cycling applications.** Silvestri, G.J. Jr.; Martin, H.F. (Westinghouse Electric Corp., Orlando, FL). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Steam generating units are increasingly being operated in a cyclic mode. Cycling typically consists of either load following operation or two shifting or a combination of both. In the former instance the steam turbine generating unit operates at varying load according to system load demands and often operates at low load, as low as 10% of rating, overnight. In the latter case the steam turbine is off-line overnight and/or weekends. The improvement in steam turbine heat rate and cyclic life that results from sliding or variable throttle pressure operation, as compared to other methods of operation, has resulted in wide acceptance of this innovation. With full-arc admission (single valve designs) every first stage nozzle is active at all load conditions. In contrast the number of active first stage nozzles is varied in response to load changes on partial-arc admission (sequential-valve) turbine designs. Moreover, the nozzles of the partial-arc design are separated into discrete groups, contained in individual chambers. The chambers may be separate from or integral with the high pressure shell and are supplied with steam from individual inlet pipes and control valves. The performance of partial-arc admission steam turbines for cycling applications is discussed.

11142 (EPRI-CS—4723, pp 6.25-6.38) **Modeling of alternative steam bypass systems for hot restarts.** Boroughs, R.D.; Keever, S.L. (Tennessee Valley Authority, Chattanooga). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

In evaluating alternative steam bypass systems for unit 8 at Widows Creek Fossil Plant, TVA used a computer model developed by Combustion Engineering. Three different bypass configurations were modeled: (1) a single-stage bypass from the superheater outlet to the condenser, (2) a 2-stage bypass from the superheater outlet to the reheater inlet, then from the reheater outlet to the condenser, and (3) a superheater bypass directly from the drum to the condenser. Finally, a split-bypass system, combining options 1 and 3, was modeled. Each option is characterized by a graph of superheat outlet temperature versus time. It was found that to accomplish a hot restart without violating guidelines for steam pressure or furnace gas exit temperature, it is necessary to dispose of about 13% of the full-load steam flow. With a single-stage bypass it would be difficult to achieve steam temperatures in excess of 830°F. To achieve higher steam temperatures, a 2-stage bypass would be required.

11143 (EPRI-CS—4723, pp 6.39-6.56) **Evaluation of turbine bypass systems to facilitate cycling operation.** Glecher, G.F. (Potomac Electric Power Co., Washington, DC). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Two-shift cyclic operation can result in significant temperature differences between the steam entering the turbines and the turbine metals (i.e., temperature mismatch) during startup which results n high thermal stresses. In addition, turbines are often subjected to large temperature changes during an overnight shutdown. PEPCO is currently examining the advantages of a turbine bypass system and revised operating procedures as a means to reduce large temperature mismatches. Techniques to reduce the overall temperature changes in the turbine metal during an overnight shutdown are also being studied. Utilizing a main steam bypass in conjunction with the maintenance of high steam temperatures and variable pressure operation satisfactorily addresses both of the detrimental temperature phenomenon.

11144 (EPRI-CS—4723, pp 6.57-6.91) **High pressure feedwater heater experience on cycling units.** Dyr, R.J.; DeRosa, P.P. (Florida Power & Light Co., Juno Beach). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

With the shift in operating practices of many fossil plants, one can also expect a change in the type of problems and anomalies these plants will be encountering. Many plants are being used more and more as cycling units, rather than continuing the base load operations for which they were originally designed. Though much attention in the recent past has been directed toward steam generator and turbine cycling reliability, these new duty cycles may well shift the weak links to the structural integrity of major auxiliary equipment pressure boundaries. The discovery, evaluation, and correction of service induced cracks found in the channel head-tubesheet complex pressure boundary of high pressure feedwater heaters are discussed. Moreover, a process, a programmatic approach to root cause analysis built upon the synergistic interaction of utility engineering, operations, and maintenance talent further enhanced through expertise provided by an outside consultant is described. The successful management and control of this extensive problem demonstrates that a synergistic team approach enhanced the engineering process.

11145 (EPRI-CS—4723, pp 6.93-6.113) **Oxygen control in cycling power plants.** Oliker, I. (Burns and Roe, Inc., Oradel, NJ). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Cycling of large fossil power plant units during two-shift and load-following operating modes is accompanied by numerous problems. One of the major problems is the accelerated corrosion rate of the condensate/feedwater system during cycling operation. Corrosion not only causes failure of components but also decreases heat transfer and, consequently, plant output. Experience in operating and maintaining steam generators and turbines indicates the great difficulty and sometimes impossibility of removing corrosion products from them. Therefore, efforts must be made to minimize ingress of impurities into the feedwater cycle. Oxygen, the main cause of corrosion, penetrates the balance of plant (BOP) system in the forms of air inleakage in the vacuum sections, cooling water inleakage, and makeup water. Most of this oxygen inleakage occurs in the condenser. The deaerating capability of the condenser is substantially reduced at low loads and startups with resultant increase in oxygen concentration in the condensate. Oxygen can also cause corrosion damage to carbon steel and low alloy steel during outage conditions. These corrosion problems that indicate the need for

deaeration throughout the system during the cycling operation are discussed.

11146 (EPRI-CS—4723, pp 7.1-7.7) **Session A-1: boiler and related auxiliaries.** Parris, D.S. (Potomac Electric Power Co., Washington, DC). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The Boiler Group discussed some of the problems different utilities have encountered with their boilers which are part of cycling units. The utility representatives presented the various approaches that have been taken to address these problems. A general consensus emerged as to the most effective corrective action for some of the detrimental consequences of cycling. For other problems, striking dissimilarity was evident thereby affording many of the participants the opportunity to re-examine their current practices. A summary of the discussion organized by topic is presented.

11147 (EPRI-CS—4723, pp 7.9-7.13) **Session A-2: boilers and related auxiliaries.** Branning, C.E. (Florida Power & Light Co., Juno Beach). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The working group first prioritized the topics for discussion, then, starting with the top priority, reviewed each topic as time permitted. The following items are discussed: pressure parts, cast, operation, and corrosion.

11148 (EPRI-CS—4723, pp 7.15-7.20) **Session B-2: turbines and turbine auxiliaries working.** Bell, R.J. (Heat Exchanger Systems, Inc., Boston, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The calculation of turbine rotor stress is based on axi-symmetric, infinitely-long thick-cylinder theory. Much of the data required to perform the calculations is considered proprietary information by the manufacturers. Various manufacturers use different methods to calculate temperature and stress distributions through the rotor. Some apply empirical correction factors, making comparisons of performance between various units of doubtful value. Problems in determining rotor stresses, cyclic life, and operation are reviewed.

11149 (EPRI-CS—4723, pp 7.21-7.26) **Session B-1: turbines and auxiliaries.** Diaz-Tous, I.A. (Encor-America, Inc., Los Altos, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

Working Group II generated a discussion which addressed several pertinent issues regarding turbines and turbine auxiliaries in cycling service. This group was attended by people with widely diverse backgrounds. These included utilities consultants, architect/engineers, and manufacturers. The participation of Florida Power and Light (FP & L) personnel was of particular benefit because of this utility's cycling experience. In addition, the utility personnel present included a station manager, a maintenance superintendent, I & C/test engineers, and performance engineers. The discussion were divided evenly among turbine and turbine auxiliary topics. The turbine topics included: on- and off-line monitoring, instrumentation/controls, hybrid turbine operation, and turbine water induction. The turbine auxiliary topics included feedwater heater-related water-induction problems, inability to drain feedwater heaters at low loads, drain system designs, turbine bypasses, and feedwater heater-channel cracking. The general scheduling was also discussed.

11150 (EPRI-CS—4723, pp 7.27-7.31) **Session C: controls.** Wong, F.K.L. (Electric Power Research Institute, Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920007. (CONF-8511233—).

From Fossil plant cycling workshop; Miami Beach, FL, USA (5 Nov 1985).

The group identified the following topics on the role of control systems in cycling of fossil power plants, i.e., goals, control problems, current solutions, and R & D needs. Each of these topics is reviewed.

11151 **(EPRI-CS—4778) Generic guidelines for the life extension of fossil fuel power plants: Final report.** McNaughton, W.P.; Richman, R.H.; Pillar, C.S.; Perry, L.W. (Daedalus Associates, Inc., Mountain View, CA (USA); Delian Corp., Monroeville, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 363p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920151.

These generic guidelines were developed under the EPRI project for fossil-fuel power plant life extension - RP2596. In addition to compiling the findings of four utility life extension projects, the guidelines incorporate worldwide experience in the residual life assessment and life extension of fossil-fuel power plant components. The guidelines are aimed at assisting those utilities without formal life extension programs to formulate initial life extension planning studies and to provide guidance in the subsequent implementation of a life extension strategy. For utilities with existing programs, the guidelines provide technical life assessment guidance and also serve as a checklist for the periodic review and updating of the programs. The guidelines review life extension on three organization levels - (1) corporate and system planning issues, (2) life assesment (plant) planning issues and (3) life extension implementation. They provide a logical, stepwise procedure for establishing or revising a life extension program. The guidelines, particularly the section on life extension implementation, are structured in a three-level approach in which increasingly costly and accurate residual life assessments are performed only as needed. A phased approach to life extension is introduced as a potentially cost- and resource-effective way of implementing life extension activities. Each step of the life extension process is illustrated with examples of the manner in which the implementation may typically occur. However, given the variety of circumstances facing each individual utility, the emphasis is on those steps that are typically performed and not upon recommending the details of a particular life extention program. 51 refs., 68 figs., 26 tabs.

11152 **(EPRI-CS—4860) Alternative combustion turbine designs and cleanup systems for pressurized fluidized-bed combustion (PFBC) power plants: Final report.** Wenglarz, R.; Lippert, T.; Alvin, M.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Oct 1986. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920104.

This report explores effects of alternative gas cleanup systems and utility combustion turbine designs on costs and turbine erosion, deposition and corrosion tolerances for pressurized fluidized bed combustion (PFBC) power plants. The first type of turbine design variation involves ruggedization to increase expander tolerances to the degrading tendencies of PFBC expansion gases which contain particulate and chemical contaminants. The second type of variation involves turbine design to permit expansion of PFB combustion gases below 1000°F. Such turbine designs would be applied to PFBC turbocharged boilers. Utilizing these turbine designs, three specific turbine/power plant configurations operating with alternative gas cleanup systems are evaluated and compared. One plant configuration utilizes an existing conventional utility turbine; the second utilizes a ruggedized version of that machine; the third uses a turbine specially modified for the PFBC turbocharged boiler. The alternative gas cleanup systems involve proven cyclones and advanced ceramic bag and candle filter devices currently being developed. Since ruggedized and low temperature utility turbines do not currently exist, specific flow path designs for these turbines matched to the specified power plant configurations were obtained in this work. To minimize the cost of providing ruggedized and

low temperature turbines for PFBC power plant applications, the machines identified for evaluations are modified versions of existing turbines. Using the expander flowpath descriptions, maintenance intervals and corrosion potential were estimated and compared for all three turbines operating with their respective power plants and alternative gas cleanup systems. Turbine and gas cleanup equipment costs are also estimated and compared for the three PFBC power plant configurations. 14 refs., 14 figs., 17 tabs.

11153 **(EPRI-CS—4862) Advanced dry-cooling demonstration: Summary: Final report.** Fricke, H.D.; Czikk, A.M.; Helenbrook, R.G.; McHale, C.E.; McIlroy, K.; Webster, D.J. (Union Carbide Corp., Tonawanda, NY (USA). Linde Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 55p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920149.

An ammonia phase-change dry cooling system of increased thermal performance for electric power stations was investigated. It features the potential for significant cost savings over conventional dry cooling plants. Economic optimization studies indicate a 58% PWRR reduction from the dry-closed water loop which translates into a 4.4 mills/kWh savings over the plant life. The initial feasibility of the phase-change concept, including improved heat transfer technologies, was successfully demonstrated with a pilot plant (0.3 MWe) designed, built and operated by Union Carbide Corporation-Linde Division. It features Union Carbide's doubly enhanced condenser/reboiler, having a porous boiling surface (High Flux) on the ammonia-side, a thin film condensing promoter on the steam-side, and an air-cooled ammonia condenser utilizing Curtiss-Wright shaved fin extruded aluminum tubing. Overall heat transfer coefficients ranging from 1000 to 1440 Btu/h ft^2 ^{0}F were measured at an ammonia flow rate of 1 gpm/tube in the condenser/reboiler and 7.0 to 8.6 Btu/h ft^2 ^{0}F in the Curtiss-Wright condenser. Pilot plant tests with a water-deluged Hoterv plate-fin/tube ammonia condenser demonstrated heat transfer enhancements four times that over its dry operation. Union Carbide subsequently participated with Battelle (PNL) in the design, construction and testing of a 15 MWe ammonia phase-change dry/wet cooling demonstration plant. The development of this facility was based on the design criteria and operating experience established from the pilot plant. The operation of the ACT system has been smooth and controllable with predicted performance of the key components achieved, thus demonstrating the feasibility of the ammonia phase-change concept on a scale larger than the pilot plant. 19 refs., 8 figs., 4 tabs.

11154 **(EPRI-CS—4914) Water blowing of fireside deposits in coal-fired: Utility boilers: Final report.** Kuchner, R.A.; Lee, D.R.; Wesley, D.A. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). Nov 1986. 342p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920111.

The conclusions derived from the results of the laboratory test, field test and analytical effort were: (1) Furnace-wall tubes constructed of SA 213-T2 (low-chromium alloy) will live much longer when subjected to water lancing than walls constructed with SA 210-A1 (carbon steel) tubes. (2) Failures that occur in furnace-wall tubes as a result of water lancing are expected to be minor leaks from narrow circumferentially oriented cracks, rather than catastrophic tube ruptures from longitudinally oriented cracks. (3) The effect of slag on reducing thermal shock imparted to a tube wall is complex and was not quantified with the limited data obtained prior to the failure of instrumentation in the harsh boiler environment. (4) Fatigue crack growth analysis is a more appropriate method for estimating the onset of failures in carbon-steel (SA 210-A1) furnace-wall tubes subjected to water lancing than fatigue (S-n) analysis. (5) The recommended analytical method to predict the onset of tube failures in furnace wall tubes is applicable to carbon-steel (SA 210-A1) tubes. However, this method is not recommended for low-chromium alloy tubes. (6) Lance parameters significantly affect life of carbon-steel (SA 210-A1) boiler tubes subjected to water lancing. Progression velocity is the most important lance parameter; nozzle size and water pressure are important at faster progression velocities. Tubes with thick walls will live longer than tubes with thin walls for a given set of lance conditions. 18 refs., 156 figs., 38 tabs.

11155 **(EPRI-CS—4969) Circumferential cracking of supercritical boiler water-wall tubes: Final report.** Cialone, H.J.; Wright, I.G.; Wood, R.A.; Jackson, C.M. (Battelle Columbus Div., OH (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 80p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920157.

This report describes the results of a study of circumferential cracking in the waterwall tubes of supercritical boilers, in which the objectives were to assess the extent of the problem and identify probable contributing factors. Correlations were sought among a variety of possible causative factors in those units experiencing cracking that was characterized as severe or moderate. Factors such as operational features, boiler design, maintenance procedures, waterwall tube materials and coatings, feedwater treatments, and coal compositions were investigated. In addition, comparisons were made among units that were similar in design. Also, information regarding recent experience with corrective measures was obtained. The investigation resulted in a vast body of information regarding circumferential cracking, which was catalogued and compiled in a convenient format (computer database) for evaluation and interpretation. However, no common factors among those units that have experienced circumferential cracking were evident that were not also observed among units that did not suffer cracking. It appears that a combination of factors that promote thermal cycling and an aggressive environment at the fireside surface of the waterwall must be present to form cracks. The individual influence of each of the contributing factors could not be determined, primarily because of the relatively high frequency of changes in factors such as operation and maintenance procedures compared with the frequency with which detailed inspections to detect cracking have been performed. Thus, it was concluded that further research is needed in which direct measurements are made of the various factors identified in this study and frequent correlative evaluations of waterwall cracking are performed by the project team in close collaboration with utility personnel. 8 refs., 5 figs., 17 tabs.

11156 (EPRI-EA—4857, pp 2.1-2.18) **Utility planning under uncertainty.** Oatman, E.N. (Strategic Decisions Group, Menlo Park, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Electricity supply and demand at three points in time were studied. How existing capacity has been used to meet the needs of today's consumer during a period of great uncertainty was examined. The prospective supply/demand balance over the next decade and how uncertainties in demand, demand side management, planned capacity and flexibility affect operating margins over the next decade were studied. The current planned capacity of electric utilities at the size of the planning gap that would exist under a broad range of uncertain demand outcomes was investigated. The objective of planning under uncertainty is to provide the utility manager with a wide range of options, i.e., options that cut across traditional boundaries of supply and demand; options that serve fundamental customer needs for light, heat, etc., while maintaining a financially sound corporate entity; and options that are flexible, resilient and defensible in the face of risk and uncertainty.

11157 (EPRI-EA—4857, pp 3.1-3.29) **Uncertainty in utility fuel requirements through 2010.** Keelin, T.W. (Strategic Decisions Group, Menlo Park, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Understanding fuel requirements uncertainty is essential in making today's fuel planning decisions. Point-estimate price and availability forecasts for individual fuel markets provide an incomplete picture of underlying economic and regulatory uncertainties and of the potential for interfuel substitution. Without this information, it is difficult for utilities to make sound and defensible decisions about fuel procurements for existing capacity and about the fuel type and fuel switching capabilities for new or upgraded capacity. A conceptual framework that individual utilities can use for

estimating these uncertainty ranges is presented. National data are used both for illustration and to provide insight about the national situation. The modeling techniques employed to develop consistent deterministic fuel-use projections for the nation's utilities are explained. The uncertainties that underlie these projections are examined and form the basis for the deterministic sensitivity results. The probabilistic analysis more fully describes the uncertainty surrounding the estimates of national fuel requirements.

11158 (EPRI-EA—4857, pp 4.1-4.10) **Fuel-use uncertainty and increasing competition.** Hughes, J.P. (Niagara Mohawk Power Corp., Syracuse, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Recently, environmental regulation, oil price shocks, periods of hyperinflation and high interest rates, and demand-side pressures have put utility planners on the defensive with ratepayers, regulators and stockholders. The enormous embedded capital structures and persistently high capital cost have severely limited the ability of utilities to efficiently react to new market conditions. Niagara Mohawk faces the following major uncertainties: the on-line date of a new nuclear unit, the impact of new state acid rain regulations and possible federal action, reorganization of the wholesale natural gas markets, the development of significant amounts of PURPA-inspired cogeneration, and a highly fickle off-system sales market. These uncertainties are compounds by the recent introduction of a partial fuel adjustment recovery mechanism and other regulatory constructs that place the company and its stockholders at risk due to forecasted fuel price and customer demand variances. To minimize risks due to fuel prices, the company has acquired a comprehensive, independent fuel pricing forecast service which forecasts not only the prices of fuels burned in its own generation units, but also for all the fuels burned by other member companies of the New York Power Pool. These prices support multi-area production costing simulations. As good as these price forecasts are, fuel-use uncertainties remain high because of poorly specified links to the company's model-based planning process. The specific components of the company's planning process are examined, structural inconsistencies related to fuel price and usage are identified and ways to construct a more comprehensive and internally consistent planning process are proposed.

11159 (EPRI-EA—4857, pp 5.1-5.7) **Effects of international economic factors on fuels planning.** Pifer, H.W. III. (Putnam, Hayes & Bartlett, Inc., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

On Sunday, September 22, 1985, the Finance Ministers and Central Bankers for the Group of Five (that is, the US, Japan, Great Britain, France, and West Germany) announced, after months of secret negotiations, a coordinated program designed to devalue the US dollar relative to other major currencies. On Monday, September 23, 1985, the foreign currency markets reacted with what was the largest one-day drop in the exchange rates for major currencies. On Friday, the Japanese yen traded at 240 yen to the dollar; by Monday, the first trading day after the Group of Five meeting, the yen dropped to 225.25 yen to the dollar, a decline of somewhat over 6%. The British pound, the French franc, and the West German mark all declined somewhat in excess of 5%. The effects of these economic factors on fuels planning are discussed.

11160 (EPRI-EA—4857, pp 7.1-7.19) **Fuel market forecasts.** Smith, D.A. (Putnam, Hayes & Bartlett, Inc., San Francisco, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Fuel market forecasts are examined. Fuel information has been collected and stored in a large database. At the 1984 EPRI Fuel Supply Seminar a prototype version of that database was demonstrated on a personal computer. A summary of recent trends and projections is presented that addresses some of the insights to be gained from looking at forecasts, particularly the insights by looking across forecasters or across time for a single forecaster. The wisdom of using forecasts for the long range is discussed.

11161 (EPRI-EA—4857, pp 8.1-8.15) **Fuel oil trends and implications for the crude oil market.** White, T. (Petroleum Economics Ltd., London, England). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

A review of the crude oil market for the period 1960 to 1985 is presented to help understand the forces that will be at play in the future. Data are presented on changes in oil consumption for this quarter of a century. The review is used to help predict future trends in oil consumption during the period 1985 to 1995. It was concluded that it will be the availability of crude oil in this period, resulting from supply considerations, that will primarily determine the demand for fuel oil and not vice versa as in the past.

11162 (EPRI-EA—4857, pp 9.1-9.8) **Residual fuel oil market behavior.** Hunter, A.J. (Petroleum Industry Research Associates, Inc., New York, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Residual fuel oil market behavior is examined in three sections. The first part is a brief history of residual fuel demand within the context of overall energy demand reviewing the importance of price changes in setting demand. The second part is a discussion of the relation between residual fuels and the higher value distillates, or white products. The last section looks at the means by which refiners can dispose of resid, turning it into higher value products or selling it as the lower value fuel oil.

11163 (EPRI-EA—4857, pp 10.1-10.8) **Structural changes in natural gas markets.** Means, R.C. (Swanson Energy Group, Inc., Washington, DC). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

The future of direct producer sales and sales by other nonpipeline marketers depends on the future of sales by pipelines. Gas sold by a pipeline is, in almost all cases, gas that is never sold by a nonpipeline marketer. If pipelines play the dominant role in gas marketing, the role of nonpipeline marketers must be a minor one. If the latter acquire a major role, it can only be by displacing sales that previously were made by pipelines. The bases for the dominant role of pipelines in gas marketing, and the possibility that that role will now pass to other kinds of gas marketers are examined. The bases for the role has been significantly weakened over the past five years. They now have been further undermined by the FERC's Order 436, issued on October 9. That order and the changes that preceded it raise significant doubts about the future role of pipelines as gas marketers.

11164 (EPRI-EA—4857, pp 11.1-11.15) **Industrial and power plant natural gas demands.** Fraser, J.T. (Tennessee Gas Transmission, Houston, TX). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

The competitive availability of natural gas to power plants will depend on: (1) market response dynamics, (2) price expectations of utilities as well as producers, and (3) generation capacity strategies. The role of industrial and power plant demands for gas and their impact on the natural gas outlook are discussed. The outlook for natural gas demand is sensitive to several major influences: (1) the fuel use and fuel capacity investment strategies in the industrial and power plant sectors; (2) the range of future energy price expectations by both producers and end-users and (3) the economic and regulatory environments. Starting with the economic and regu-

latory climates sets the overall framework for analysis. In this study the economic outlook for real GNP growth reflects business cycle activity; continuing problems with the US budget deficit; foreign product competition and a slower rate of capacity investment than previously experienced.

11165 (EPRI-EA—4857, pp 12.1-12.3) **Remarks by the session chairman.** Huntington, H.G. (Stanford Univ., CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

A review of the three presentations in the residual fuel and natural gas markets session is presented.

11166 (EPRI-EA—4857, pp 18.1-18.17) **Integrated fuel and utility planning.** von Rosenberg, A.J. (City Public Service Board, San Antonio, TX). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

City Public Service is the municipally-owned utility serving the approximately one million residents of San Antonio and Bexar County, Texas. The city purchased the utility system from American Light and Traction Company in 1942 for $42 million. Today the assets exceed $2.7 billion and the city of San Antonio equity is in excess of $940 million. Last year the utility contributed $95,507,000 to the city which helps to maintain a relatively low property tax rate. Planning for new electric generating additions had been a relatively easy task. It consisted primarily of meeting peak demand with gradually increasing unit sizes to take advantage of economy of scale. Selecting fuels for those relying on 20-year fixed price contracts is described. The energy crisis of the early 1970s accelerated by the Arab oil embargo brought on real changes in the simplistic planning process. This process is discussed.

11167 (EPRI-EA—4857, pp 19.1-19.3) **Remarks by the session chairman.** Barbour, H.H. (Virginia Electric and Power Co., Richmond). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Utility managers and planners bear the direct responsibility for insuring reliable, efficient services to the customers. It is necessary to improve the efficiency and effectiveness of operations to hold down increases in consumer rates. To do this one must keep abreast of the changing times. The session on coal market conditions and implications for procurement is reviewed.

11168 (EPRI-NP—4769-SR, pp 1.21-1.41) **Modular redundancy concepts: problems and solutions.** Toy, W.N. (Triconex Corp., Irvine, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The reliability requirements vary considerably from application to application. In the case of computers aboard unmanned missiles or spacecraft, defective units cannot be repaired. Continuous operation is essential to a successful mission. For real-time application is, such as telephone switching or process control, the system must function correctly even when a fault is present and maintenance is being performed. Fault-tolerant computing requires redundancy to bypass an error so that the final results are correct. Redundant hardware structures that provide this capability fall into two basic categories: static redundancy and dynamic redundancy. Both of these may play a role in the same system. When static redundancy is used, the spare units are permanent parts of the system. They correct errors or mask them from propagating through the system. The masking function takes place automatically: corrective action is immediate and wire-in. Multiple copies of a system module may be used, as in the case of triple modular redundancy (TMR) systems. When three or more copies of a system module are employed, the comparison check is referred to as voting. The dynamic approach of increasing reliability requires redundant system modules in a dynamic way. Various aspects of redundancy concepts are discussed. Although they were developed for critical applications, such as space, telecommunication and nuclear energy, these concepts are now being applied to a broader field of applications, particularly in the process control. The rapid advances din VSLI and microprocessor technology make possible the realization of cost-effective fault-tolerant systems.

11169 (EPRI-NP—4769-SR, pp 1.45-1.60) **Fault-diagnosis in microcomputer based systems.** Kraft, G.; Vaidya, A. (AT & T Bell Labs., Naperville, IL). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Fault diagnosis in microcomputer-based systems is discussed in outline form. Diagnosis goals, features assisting diagnosis, error signals as observation paints, diagnostic access control, and remote processor diagnosis via data links are discussed.

11170 (EPRI-NP—4769-SR, pp 1.123-1.136) **Recovery techniques in a distributed power systems environment.** Kraft, G.D.; Shahidehpour, S.M. (IIT, Chicago, IL). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Perhaps the foremost demands made by utility engineers to the control scheme in a power plant are those of security and dependability for a wide range of power systems effects. Increasing progress towards the automation of power plants has led to the requirements for digital communications between the elements of automated systems. The point-to-point wiring schemes conventionally used for analog signal transfer in power plants are not suitable for high speed data transmission with high noise immunity. A new technology employing the latest local area network (LAN) concepts offer the most attractive mechanism for meeting the requirements of an automatically controlled power plant. The recovery strategy of LAN's in a classical shared resource environment must be modified for the automated power plant because of the significant safety requirements dictated for such installations. A token-passing, ring architecture as a potential vehicle for high reliability/safety operation of an automated power plant is described. The mechanism for recovery from specific faults that are detected are outlined, as well as, recommendations for recovery strategies to be considered using alternative power plant-LAN architectures.

11171 (EPRI-NP—4769-SR, pp 2.33-2.72) **Wide range digital control systems for integrated unit control of fossil fired plant at Kingsnorth Power Station.** Conner, A.S. (CEGB-Scientific Service Dept., Gravesend, England). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The existing discrete analogue control equipment provided for the dual fired (coal/oil) power station at Kingsnorth was designed to operate over a load range of 70% to 100% MCR. With the increasing demands for wide load range flexible plant operation it has been decided to replace the existing systems with a digitally based distributed control system. This system will have an operating range of 5% to 100% and will be capable of controlling each unit to enable it to make a consistent contribution towards grid system frequency regulation, provide fast two shift operation and be capable of controlling the plant following sudden demanded grid load reductions of up to 20% MCR. Enhanced operational displays will be provided to the operator to assist him with his task of efficient plant management. Special displays will also be provided to assist the operating staff with the minimization of both boiler and turbine losses. Details of both the control strategy proposed and the equipment selected to carry out the control and display functions are given.

11172 (EPRI-NP—4769-SR, pp 4.95-4.116) **Control system design and compensation with a signal-processing microprocessor.** Slivinsky, C.; Borninski, J. (Univ. of Missouri, Columbia). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

To an increasingly greater extent it is now possible to meet the control system requirements with either analog or digital technology. In these cases the designer must trade off the key issues of cost, size, weight, power, and reliability in selecting the best control system. Such tradeoffs are dependent on the particular application and are not discussed here. The study is confined to the algorithms, hardware, and software for digital control system compensation and implementation, with an emphasis on the Texas Instruments TMS32010 signal-processing microprocessor.

11173 (ESC-WR—85-18) **Saving in costs in the electric power generating sector by introducing wind power.** Bruggink, J.J.; Boonekamp, P.G.; Koenders, N.J.; Turkenburg, W.C.; Alsema, E.A.; Van Wijk, A.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum; Rijksuniversiteit Utrecht (Netherlands)). Jun 1985. 25p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Dutch government has plans for introducing wind power. It aims at 1000 MW in the year 2000. Introducing wind power results in: using less fossil fuels, operating a smaller total capacity of conventional electric power generating units, and having investment and maintenance costs for wind power units. Calculations with help of two computer simulation programs, SEPU and BEVAP, lead to Dfl. 0.108 per kWh in the year 2000 with 1000 MW wind power installed. Corresponding break-even investment costs for wind power units having a 15 years operational life span are: Dfl. 2270 per kW. Results of sensitivity analysis are presented. 8 tabs., 8 refs.

11174 (EUR—10390-EN/FR) **24,65 MW bagasse-fired steam power plant. Demonstration project. Final report.** (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 178p. (In French and English). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

The aim of the bagasse (sugar-cane residue) power plant project is to demonstrate that it is possible to use a renewable source of energy to make up the energy shortfall of the Island of Reunion over the next few years. In fact, Reunion produces 2,400,000 tonnes of sugar cane a year, which provides 700,000 of bagasse, equivalent to 140,000 tonnes of oil. The Beaufonds power plant has an output of 24.65 MW and can supply the Electricite de France grid with 37 million kWh each year during the sugar season, which is precisely when hydroelectric energy is in short supply and additional power has to be generated by diesel-fired plant. The Commission of the European Communities has provided FF 13,250,000 of the total investment cost of FF 68,686,000 as part of its alternative energy demonstration programme. However, FF 3,975,000 of this contribution have been repaid under the technical and economic success clause.

11175 (GB—45, pp 1-17) **Rotary air preheaters on power station boilers.** Chew, P.E. (Central Electricity Generating Board, Southampton, UK. Marchwood Engineering Labs.). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

The main aspects of the operation and performance of Ljungstrom type heaters on coal fired plants are discussed, covering the areas of thermal performance, pressure losses of the air and gas streams and leakage of air into the gas stream. The degradation of thermal performance due to fluid by-passing the heat exchange elements and flow maldistribution is discussed, and means of improving thermal performance are referred to. A major incidence of severe fouling is described, together with measures adopted to overcome the problem. Reference is made to a new method for off-load cleaning of air heaters. Engineering developments and theoretical approaches aimed at reducing air cross leakage are outlined.

11176 (STEV-NYEL—86-4) **Minor thermal power station Vaernamo 7 MW/sub/(e)/15 MW/sub/(v)/.** Rasmusson, N.O. (Statens Energiverk, Stockholm (Sweden)). Jul 1986. 68p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750630.

The aim of this investigation is to plan for the development of small automated power plants fuelled by indigenous fuels. The fuel consumption is calculated to be maximum 136 GWh per year. The construction cost will be 106 MSEK and the operating cost 3.1 MSEK per year, fuel included. It will take 3.5 years from the start of the project to commercial operation. (G.B.).

11177 **Coal-fired power plants in Japan.** Armor, A.F.; Preston, G.T. *Materials and Components in Fossil Energy Applications;* No. 63, 5-6(1 Aug 1986).

As part of its research and development program on advanced steam plants, the Electric Power Research Institute (EPRI) recently conducted a two-year study of Japanese planning, design, operation, and maintenance practices for coal-fired power plants. Although only about 4% of the electricity in Japan is generated from coal (1983 data), it is planned that coal firing will account for 11% of Japan's generating capacity by 1995. All new coal-fired power plants will use supercritical steam pressures in order to attain high efficiency (low heat rates). The results of the study are described.

11178 **Characterization of coating processes and coatings for steam turbine blades.** Qureshi, J.; Levy, A.V.; Wang, B. *Materials and Components in Fossil Energy Applications;* No. 63, 2-3(1 Aug 1986).

From International conference on metallic coatings; San Diego, CA, USA (Apr 1986).

During boiler transients (start-up and cool-down cycles), the magnetite scales that form on the internal surfaces of the superheater and reheater tubes at elevated temperatures may spall and enter the steam flow. Such particles may then accumulate at various points in the steam circuit and eventually disrupt the flow of steam, or they may be entrained in the steam and eventually cause erosion of blades in the steam turbine. Coatings are being considered as one method to minimize this problem in the future. Boiler manufacturers have developed chromizing diffusion and chromate conversion coatings to reduce internal scale formation in boiler tubing. Service experience over three years indicates that boride diffusion coatings on high-pressure stationary nozzle vanes can double the vane life. Based on that experience, many high pressure nozzle vanes have been boride diffusion coated specifically to increase their erosion resistance. Ten different coatings were selected - based on available field and laboratory experience in various erosive applications - for evaluation for use on rotating and stationary blading. Of the ten coatings, six different processes were considered. These processes are discussed.

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REFER ALSO TO CITATION(S) 10735, 10758, 10759, 10761, 10832, 11125, 11140, 11177, 11906

11179 (AD-A—173563/8/XAB) **Experimental study of stack plume rise and dispersion at the power station.** (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 10 Oct 1986. 21p. (FTD-ID(RS)T—0693-86). NTIS, PC A02/MF A01.

This paper describes the primary results of stack plume rise and dispersion experiment at Xu Zhou power station during November-December, 1978. (1) Under neutral and near-neutral stratification conditions, the 2/3 power law is the optimizing formula up to date, because of its calculated values in coincidence with observed. (2) Vertical of the buoyant plume from the tall stack is obviously stronger than that of non buoyant plume from the low stack. It is shown that the concept sof Pasquill(1976) model are ac-

ceptable, but formula should be modified. (3) From reliable monitoring data of SO_2 ground concentration, it is found that the effects of topography and stack height should be comprehensively taken into account in estimating dispersion by gaussian model. (4) It is suggested that in analyzing the stereophoto grammetric data of fluctuating plume, the square deviation of plume distribution should be considered as the sum of two parts--the distribution square deviation of the plume particulates relative to the instantaneous center line of the plume, and the distriubtion square deviaton of the instantaneous center line relative to the average center line of the plume. (5) Lidar is shown to be as effective as steroegraphic method in studying behavior of chimney plumes.

11180 **(DOE/MC/21337—2209) Performance evaluation of a ceramic fabric bag filter on a bench-scale coal gasifier: Final report.** Chang, R.; Sawyer, J.; Lips, H. (Acurex Corp., Mountain View, CA (USA). Environmental Systems Div.). Oct 1986. Contract AC21-84MC21337. 185p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87001022.

The objective of this project was to demonstrate the technical and economic feasibility of using high-temperature ceramic filters for particulate control in combined cycle coal gasification power plants. The overall program strategy involved three major tasks: (1) investigation of alternate designs; (2) bench-scale gasifier filter evaluation; and (3) economic assessment of a commercial-scale gasifier filter. This report presents detailed descriptions and conclusions for each task. The tests and preliminary economic assessment show that ceramic bag filters are potentially attractive candidates for gasifier particulate cleanup. 70 figs., 33 tabs.

11181 **(DOE/MC/21388—2227) Sorption of fuel-bound contaminants for coal-fired gas turbine systems: Final report.** Boni, A.A.; Garman, A.R.; Simons, G.A.; Parker, T.E. (Physical Sciences, Inc., Andover, MA (USA)). Sep 1986. Contract AC21-84MC21388. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001037.

The sorption of sulfur and alkali species and the effects of interaction between sorbents used for removal of these species and the coal ash in its various modes of appearance in heat engine combustion systems were studied. Predictive models for sulfur and alkali sorption and to obtain estimates for the capture of these species in potential heat engine applications. It is necessary to control the sulfur emissions because the oxides of sulfur have been identified as precursors to acid rain and also react within and subsequent to the combustion process to form species, such as alkali sulfates, which may be transported to and react to produce corrosive deposits on the surfaces of the heat engine power train. Candidate sorbents for removing these species from the gas phase include lime and dolomite materials for the sulfur oxides, and aluminosilicates for the alkalis. These sorbents were evaluated in the high presure region appropriate to heat engine applications.

11182 **(EPRI-CS—4847) The effects of SO_2 scrubber chemistry on corrosion: Final report.** Mansfeld, F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Oct 1986. 81p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920108.

The effects of 13 trace elements on the corrosion behavior of Ferralium 255, Hastelloy G3, stainless steel (SS) type 317L, Monit and Ti grade 2 immersed in an aerated baseline solution containing chlorides and sulfates at pH = 1 or 4 in the presence of SO_2 have been studied using electrochemical techniques. In a first series of experiments, a Plackett-Burman test matrix was used to determine which of the trace elements have a significant accelerating or inhibiting effect. Polarization resistance measurements were carried out for electrodes which were totally immersed for the entire six-day test period and for electrodes which were exposed above the solution level, except for 1 h/day when they were immersed in the test solution. A computerized system was used to perform simultaneous measurements for all five alloys and both types of electrodes using up to ten test electrodes. The results of the electrochemical measurements were confirmed by a correlation analysis with results from solution analysis and visual observation of the number and dimensions of pits after the test. The concentration dependence of corrosion rates for the five alloys has been studied for those species for which a significant effect was observed in the first test series. For Ferralium 255, Hastelloy G3, SS 317L and Monit, an accelerating effect of Cu and Fe was observed when a certain concentration threshold was exceeded. For Ti, fluoride additions of 1000 ppM produced etching of the surface at pH = 1. A comparison with the results of the first test series shows that addition of Al at comparable concentrations can prevent this corrosion damage by complexing the fluoride ions. 6 refs., 13 tabs., 37 figs.

11183 **(EPRI-CS—4861-Vol.1) Calcium sulfite and calcium sulfate crystallization: Volume 1, Effect of crystallizer type on gypsum size distribution: Final report.** Randolph, A.D.; Kelly, B.J.; Keough, B. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 71p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920146.

The purpose of this study was to measure crystal growth and nucleation kinetics of calcium sulfite hemihydrate with or without trace quantities of potential crystal modifiers and using different scales of crystallizer operation. The Crystal-Size Distribution (CSD) and morphology of calcium sulfite was observed in 240 ml and 9-liter continuous precipitators using $CaCl_2$ and $Ca(OH)_2$ to precipitate $NaHSO_3$ in solutions resembling FGD liquors. Estimates of crystal nucleation and growth rates were obtained from these CSD data and correlated in a useful kinetics form suitable for CSD predictions in a computer model which simulates complex crystallizer configurations. These population balance-based CSD studies indicated that significant improvements in calcium sulfite particle size might be achieved by using precipitators with a size-dependent particle removal configuration. 25 refs., 20 figs., 9 tabs.

11184 **(EPRI-CS—4861-Vol.2) Calcium sulfite and calcium sulfate crystallization: Volume 2, Kinetics of calcium sulfite crystallization and predictions of crystal-size distribution: Final report.** Randolph, A.D.; Vaden, D.E. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 80p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920147.

Manipulation of the Crystal-Size Distribution (CSD) of gypsum from simulated flue gas desulfurization (FGD) liquors was studied using a bench-scale classified crystallizer configuration of the Double Draw-Off (DDO) type. This configuration allows for removal of two streams; one completely mixed (underflow) and one classified (overflow) containing only particles less than ca. 30 μm. Operation of a crystallizer in the double draw-off mode allows a size-dependent separation of particle residence times with decreased removal rate of product particles vis-a-vis overflow fines thus producing a significantly larger-sized average product. Variables which were studied for their effect on CSD were overflow/underflow ratio (DDO ratio), agitator rpm, over-all liquid phase retention time, pH, citric acid (crystal modifier) concentration, rate of make based on precipitant feeds and crystallizer configuration, i.e., DDO or Mixed Suspension Mixed Product Removal (MSMPR) operational modes. Conditions were found using the DDO configuration with citric acid addition to consistently produce a larger-size gypsum product averaging 130 to 180 μm (underflow, mass average size) with a rounded aggregate-like habit having excellent filtration properties. Citrate concentration in the product crystals was found to be less than 50 ppM. Prediction a priori of CSD and residual supersaturation (proportional to fouling tendency) with the author's Mark V CSD simulator using the process conditions of this study and the nucleation-growth rate kinetics previously developed by Etherton (EPRI CS1885) was in agreement with experimental results. A large-scale FGD by-product gypsum crystallizer could be confidently designed using the technology demonstrated in this study. 5 refs., 26 figs., 9 tabs.

11185 **(EPRI-CS—4918-Vol.1) Proceedings: Sixth symposium on the transfer and utilization of particulate control technology: Volume 1.** (Radian Corp., Research Triangle Park, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 464p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920153.

These Proceedings document the Sixth Symposium on the Transfer and Utilization of Particulate Control Technology, held February 25 through 28, 1986, in New Orleans, Louisiana. The Symposium was sponsored by the US EPA's Air and Energy Engineering Research Laboratory in Research Triangle Park, North Carolina, and EPRI's Coal Combustion Systems Division, in Palo Alto, California. The objectives of the Symposium were to provide an opportunity for the exchange of knowledge and to stimulate new ideas in the field of particulate control research with the goal of extending the technology and aiding its diffusion among designers, users, and educators. Fabric filters and electrostatic precipitators were the major topics, but novel concepts and advanced technologies were also explored. Volume 1 of the Proceedings contains 26 papers presented in the Scrubbers, Opacity/Measurements, Advanced Energy Applications I and II, and Integrated Control Processes I and II Sessions. Volume 2 of the Proceedings contains 35 papers on electrostatic precipitator technology presented in the Hot-Side Precipitator, Performance Enhancement I and II, Performance Estimating (Modeling), Advanced Technology, Fundamentals I and II, Control and Energy Consumption, and Design Considerations Sessions. Volume 3 of the Proceedings contains 23 papers presented in the FF: Advanced Concepts I and II, FF: Practical Considerations, FF: Pilot-Scale Studies, Operation and Maintenance, and Fugitive Emissions Sessions. Seven papers presented at the Symposium (Nos. 3, 37, 41, 50, 51, 55, and 76 in the Symposium program) were not submitted for publication in the Proceedings. Papers have been entered individually into EDB and ERA.

11186 **(EPRI-CS—4918-Vol.2) Proceedings: Sixth symposium on the transfer and utilization of particulate control technology: Volume 2.** (Radian Corp., Research Triangle Park, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 579p. (CONF-860213—Vol.2). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920154.

From 6. symposium on the transfer and utilization of particulate control technology; New Orleans, LA, USA (25 Feb 1986).

These Proceedings document the Sixth Symposium on the Transfer and Utilization of Particulate Control Technology, held February 25 through 28, 1986, in New Orleans, Louisiana. The Symposium was sponsored by the US EPA's Air and Energy Engineering Research Laboratory in Research Triangle Park, North Carolina, and EPRI's Coal Combustion Systems Division, in Palo Alto, California. The objectives of the Symposium were to provide an opportunity for the exchange of knowledge and to stimulate new ideas in the field of particulate control research with the goal of extending the technology and aiding its diffusion among designers, users, and educators. Fabric filters and electrostatic precipitators were the major topics, but novel concepts and advanced technologies were also explored. Topics discussed in each day's sessions are listed below: Volume 1 of the Proceedings contains 26 papers presented in the Scrubbers, Opacity/Measurements, Advanced Energy Applications I and II, and Integrated Control Processes I and II Sessions. Volume 2 of the Proceedings contains 35 papers on electrostatic precipitator technology presented in the Hot-Side Precipitator, Performance Enhancement I and II, Performance Estimating (Modeling), Advanced Technology, Fundamentals I and II, Control and Energy Consumption, and Design Considerations Sessions. Volume 3 of the Proceedings contains 23 papers presented in the FF: Advanced Concepts I and II, FF: Practical Considerations, FF: Pilot-Scale Studies, Operation and Maintenance, and Fugitive Emissions Sessions. Seven papers presented at the Symposium (nos. 3, 37, 41, 50, 51, 55, and 76 in the Symposium program) were not submitted for publication in the Proceedings. Papers have been entered individually into EDB and ERA.

11187 **(EPRI-CS—4966-Vol.1) Proceedings: 1986 joint symposium on dry SO_2 and simultaneous SO_2/NO/sub x/ control technologies: Volume 1, Sorbents, process research, and dispersion.** (Radian Corp., Research Triangle Park, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 457p. (CONF-860634—Vol.1). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920156.

From Joint symposium on dry SO/sub 2/ and simultaneous SO/sub 2//NO/sub x/ control technologies; Raleigh, NC, USA (2 Jun 1986).

In 1986 Joint Symposium on Dry SO_2 and Simultaneous SO_2/NO/sub x/ Control Technologies was held in Raleigh, North Carolina, June 2 through 6, 1986. This symposium, jointly sponsored by EPRI and EPA, was the second meeting of its kind devoted solely to the discussion of emissions control processes based on dry injection of calcium or sodium sorbents to meet SO_2 and NO/sub x/ regulations for coal-fired power plants. Specific topics discussed included enhanced sorbent utilization through thermal pretreatment of sorbents or use of hydrated or promoted calcium-based sorbents, effects of temperature and other injection parameters on sulfur capture efficiency, economics of dry sorbent injection, post-furnace injection for SO_2 control, effects of dry sorbent injection processes on electrostatic precipitator performance, waste management options, and the global status of commercial-scale dry sorbent injection processes. Forty-nine papers were presented. The Proceedings of the 1986 Symposium have been compiled in two volumes. Volume 1, Sorbents, Process Research and Dispersion contains papers from the following sessions: introduction, sorbents, process research, and mixing/dispersion. Contained in Volume II, Economics, Power Plant Integration and Commercial Applications are papers presented in these sessions: economics, post-furnace SO_2 removal, system impacts, and commercial scale applications. Also included in Volume II are three unpresented papers submitted in conjunction with the Symposium or associated with a poster session held during the Symposium. Papers have been entered individually into EDB and ERA.

11188 **(EPRI-EA—4857, pp 13.1-13.30) Diversity of utility scrub-switch decision factors.** Schwartz, S.I. (Energy Ventures Analysis, Inc., Arlington, VA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

This study has focused on developing a much greater understanding of the factors that will determine utilities' decisions to reduce sulfur dioxide emissions in response to Federal legislation. This knowledge will improve the ability to forecast likely utility responses to legislation and to understand the impact on the coal market. Although emissions from oil-fired stations are included in the legislative scenarios, the analysis of emissions reduction decisions centers on coal-fired power plants. There are many existing and developing technologies available to utilities to reduce emissions of sulfur dioxide, but this study only considers the two most common choices: low-sulfur coal and GFD system retrofit. It is believed that concentrating the project's resources on these commercially-viable options would provide the most valuable results. These options include utilities operating their systems to achieve maximum effectiveness of the low-emitting power plants (i.e., least emissions dispatch). Emerging technologies like FBC and limestone injection have applications today in situations where neither switching nor scrubbing is appropriate, but their large-scale use for emissions reduction is still speculative. The conventional switching and scrubbing choices will have the greatest impact on the coal markets.

11189 **(EPRI-EA—4857, pp 14.1-14.12) Premiums for low-sulfur coal.** Rathbun, L.S.; Hughes, W.R. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

For a number of years, the US Congress has considered legislation aimed at controlling acid rain by reducing sulfur dioxide and nitrous oxide emissions of coal-fired electricity utility generating plants. One issue central to the debate over the form and timing of national acid rain legislation is the concern about the availability and price of low-sulfur Appalachian coal. The concerns focus on potential fly-up in coal prices resultant from inadequate in-place productive capacity and the question of long term reserve availability. The assessment of low-sulfur Appalachian coal supply reported here has both methodological and substantive value. Methodologically, Skelly and Loy has developed and applied a method of measuring reserves that uses similar criteria to those employed by a mining firm in making actual mineability decisions. Used as a screening tool applied to a variety of mining areas, the method per-

mits a rapid yet realistic assessment of regional mine cost considerations. Substantively, this study assessed information on excess capacity, expandability of capacity, coal quality and the magnitude of reserves in relation to potential demand.

11190 **(EUR—10501-EN/DE) Demonstration plant for an energy-saving flue gas desulphurization process. Demonstration project. Final report.** Fischer, J.; Schulte, W. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 221p. (In German and English). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

The aim of the project was the development and construction of a Walther flue gas desulphurization demonstration plant according to the Walther waste-water-free principle including startup and test operation of the plant. After an operating period of 2 years now, summing up, it may be said that the flue gas desulphurization plant on the basis of the Walther process in the superpower station Mannheim has up to now come up to the expectations regarding cleaning effectivity and end product quality of the final product which is utilized as fertilizer. Due to reheating the scrubbed flue gasses by means of a regenerative heat exchange, approximately 1,800 kg/h EL fuel oil could be saved in full-load operation.

11191 **(PB—87-119343/XAB) EPA (Environmental Protection Agency) LIMB (Limestone Injection Multistage Burner) development and demonstration program status report (April 1985). Report for February 1985-June 1986.** Martin, G.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Oct 1986. 36p. (EPA—600/8-86/036). NTIS, PC A03/MF A01.

The report summarizes the technical status of EPA's Limestone Injection Multistage Burner (LIMB) program and discusses the planned program leading to commercialization by 1990. It provides a background on the emissions of SO_2 and NOx from coal-fired utility boilers and discusses critical aspects of the LIMB process. It also provides an overview of the LIMB process and the program approach, followed by a detailed discussion of results and plans for each major technical area of the program. The goal of the LIMB program is to provide a low-cost technology for control of SO_2 and NOx for coal-fired boilers. In the U.S., the dominant source of SO_2 is existing coal-fired utility boilers, which also contribute about 20% of the total NOx emissions. LIMB is one emerging technology which has the potential to accomplish this goal in a more cost-effective manner than currently commercial technologies.

11192 **(TVA/ONRED/WRF—86/6) Gallatin Steam-Electric Plant: Paddlefish investigations: Progress report.** Pasch, R.W. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Oct 1986. 4p. NTIS, PC A02/MF A01. File Number DE87900331.

TVA has investigated young-of-year (YOY) paddlefish impingement at the Gallatin Steam-Electric Plant (GAF) for several years. The objective of the investigations has been to relate YOY paddlefish abundance and distribution in Old Hickory Reservoir to impingement mortality at GAF. Impingement at GAF was monitored and, if paddlefish impingement was significant, distribution, abundance, and health of YOY paddlefish in Old Hickory Reservoir was to be intensively studied. This approach was continued through 1986.

11193 **(AD-A—172924/3/XAB) Method of estimating the long-term average concentration from the power plant's high stack.** Fujian; Yanchang; Yunxian; Chaofu. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 9 Sep 1986. Translation of Nanjing Daxue Xuebao (China), Vol. 22, No. 1, 169-178(Mar 1986). (FTD-ID(RS)T—0689-86). 21p. NTIS, PC A02/MF A01.

Using the Gaussian plume model, this paper considered the effects of terrain, pollutant decay, and precipitation scavenging, and proposed the formula for estimating long-term average ground-level concentration for the power plant's high stack. Since parameters such as wind, stability, mixing depth, etc. were calculated from routine meteorological data, the average concentration could be estimated without any field observation. This is a method with significance in practical use and economy for selecting a preconstruction plant site and assessing air quality.

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REFER ALSO TO CITATION(S) 11470, 11471, 11576

11194 **(AD-A—173086/0/XAB) High-energy surge-arrester technology development. Part 2. Final technical report, 30 June 1982-28 February 1986 on Phase 1.** Tasca, D.M. (General Electric Co., Philadelphia, PA (USA). Space Systems Div.). 28 Feb 1986. 130p. NTIS, PC A07/MF A01.

The objective of this program was the development of improved high-energy surge arresters (HESAs) to protect installations from EMP induced on extended networks. This phase is associated with the development of a HESA for an RF/C3 transmitter antenna. A unique and innovative all-solid-state, self-recovery HESA design concept was developed using existing metal oxide varistor and saturable magnetic device technologies. This design concept, which is based on a two-element hybrid-protective-device approach, has the dual capability to provide high voltage/fast rise time and long pulse/high current threat protection. The first element provides delay free protection against the fast rise-time HEMP threat and was implemented using the metal oxide power-varistor product-line technology that General Electric developed. The second element provides the high-energy relief for the first element, and was implemented using saturable magnetics. Detailed analytical design equations were derived, and extensive material characteristics were experimentally obtained in support of this development. Much of this work involved the generation of singular information required to support the solutions to the design problems encountered in meeting the design challenge using realistic hardware. Two proof-of-principle prototype units were designed and fabricated using the technology established in the program.

11195 **(DOE/CE/15187—T8) Energy conservation by improved control of bulk power transfers on interconnected systems: Final technical progress report.** Cohn, N. (Network Systems Development Associates, Jenkintown, PA (USA)). 2 Jan 1987. Contract FG01-84CE15187. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003773.

The project objective is to introduce, test and promote licensed use of the "Cohn Components Concept," and the "Decomposition," "Improved Corrective Control", and "Equitable Payback" techniques derived therefrom.

11196 **(EPRI-EL—4650) Electromagnetic Transients Program (EMTP): Application guide: Final report.** Mauser, S.F.; McDermott, T.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Power System Engineering Dept.; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 375p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920166.

This document is an outgrowth of a survey and analysis of Electromagnetic Transients Program (EMTP) user needs, in which improved user's documentation was determined to be the single most important enhancement to the EMTP. The Application Guide covers EMTP models and studies, with many examples and typical data. The Application Guide is part of a series of new EMTP user manuals which covers program operation, theory, and application guide lines.

11197 **(EPRI-EL—4953) A remote tester for surge arresters: Final report.** Shaw, J.H. (McGraw-Edison Power Systems Div., Franksville, WI (USA). Thomas A. Edison Technical Center; Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 50p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920167.

Laboratory studies show that the most probable indication that a surge arrester is failing is electromagnetic energy emission. In field trials by eight utilities, a tester designed to detect radiofre-

quency emissions located defective arresters, but stray emissions in the environment limited its performance.

11198 **(EPRI-EL—4956) Radio interference from HVDC converter stations: Modeling and characterization: Final report.** Bhatti, J.S.; DeVore, R.V. (International Engineering Co., Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 133p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920160.

High-voltage direct-current converter stations generate electromagnetic interference (EMI) that can affect the performance of nearby electronic equipment. A prototype computer program that calculates EMI characteristics in the 5-500-kHz range will enable utility engineers to determine the extent of such interference during the design stage of a converter station.

11199 **(EPRI-EL—4984) HVDC converter stations for voltages above 600 kV: R and D needs and priorities: Final report.** Krishnayya, P.C.S.; Maruvada, P.S.; Lambeth, P.J.; Desilets, G.; Trinh, N.G. (Institut de Recherche d'Hydro-Quebec, Varennes (Canada); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 104p. Research Reports Center, Box 50490, Palo Alto, 94303. File Number TI87920159.

A study of the R and D needed to build converter stations for HVDC transmission lines with pole-to-ground voltages between 800 and 1200 kV confirmed that economical designs for more than 800 kV will require long-term R and D. Converter stations for 800 kV appear possible with existing technology.

11200 **(EPRI-EL/EA—4858-Vol.1) Polychlorinated dibenzofurans (PCDF) and polychlorinated dibenzo-p-dioxins (PCDD) in utility transformers and capacitors: Volume 1, Formation of PCDF and PCDD in askarels and contaminated mineral oil equipment: Final report.** Rouse, T.O. (General Electric Co., Pittsfield, MA (USA). Materials Lab.). Oct 1986. 33p. Research Report Center, Box 50490, Palo Alto, CA 94303. File Number TI87920123.

Many health effects originally attributed to PCBs appear to result from their pyrolysis and combustion by-products, PCDF and PCDD. This study developed improved techniques for characterizing these products and showed that PCDF and PCDD do not form during catastrophic arcing failure in transformers and capacitors.

11201 **(ORNL/TM—10293) Analysis of power wheeling services.** Tepel, R.C.; Jewell, W.; Johnson, R.; Maddigan, R. (Economic Systems Analysis, Inc., Oak Ridge, TN (USA); Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 323p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87003935.

Purpose of this study is to examine existing wheeling arrangements to determine the terms of the agreements, to analyze the terms relative to regulatory goals, and finally, to suggest ways in which the arrangements can be modified to lead to outcomes more closely in line with the goals. The regulatory goals that are considered are: Does the arrangement meet the revenue requirement of the wheeling firm? Is efficient use promoted? Are the costs fairly apportioned? And, is the arrangement practical and feasible to implement?

11202 **(TVA/OP/EDT—86/39) Microprocessor-based monitoring and control project: Phase 2 report.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Sep 1986. 126p. NTIS, PC A07. File Number DE87900345.

This report summarizes the activities of Phase II of the microprocessor-based monitoring and control project. The object of this multiphase project in the Electrical Systems Group of TVA's Division of Energy Demonstration and Technology (ED and T) is the development of microprocessor-based systems for special-purpose applications in monitoring, control, and protection of the power system. Phase II dealt with the hardware enhancements and software development to simulate the switching of the 46-kV capacitor banks at the Concord substation for voltage and VAR control.

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REFER ALSO TO CITATION(S) 12512

11203 **(DOE/S—0053) Energy Research Advisory Board Civilian Nuclear Power Panel: Subpanel 2 report, Advanced reactor development: Volume 3.** (USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board). Oct 1986. 239p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87002843.

This report is concerned with: basic goals of advanced reactor R and D; future benefits; and advanced reactor program recommendations. (JDB)

11204 **(IHZ-WIK—85-533/601/2) Conference proceedings of session II. 16-18 April 1985.** (Ingenieurhochschule Zittau (German Democratic Republic)). 1985. 59p. (CONF-8504237—Pt.2). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780051.

From 7. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (16 Apr 1985).

The individual papers in this meeting have been abstracted separately.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 11232, 11248, 11249, 11250, 11251, 11252, 11253, 11254, 11255, 11256, 11257, 11258, 11259, 11260, 11269, 11272, 11276, 11280, 11284, 11304, 11325, 11330, 11332, 11334, 11335, 11336, 11337, 11338, 11339, 11340, 11341, 11342, 11343, 11344, 11345, 11346, 11347, 11348, 11349, 11350, 11351, 11355, 11356, 11357, 11358, 11360, 11361, 11362, 11363, 11364, 11365, 11366, 11367, 11368, 11369, 11371, 11380, 11386, 11397, 11399, 11403, 11404, 11406, 11407, 11409, 11413, 11414, 11624

11205 **(EPRI-NP—4767) Evaluation of BWR top-guide integrity: Final report.** Gerber, T.L.; Kuo, A.Y.; Copeland, J.F.; Rashid, Y.R.; James, R.J.; Sullaway, M.F. (Structural Integrity Associates, San Jose, CA (USA); Anatech International Corp., La Jolla, CA (USA)). Nov 1986. 112p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920132.

This study was undertaken to evaluate the potential significance of Irradiation Assisted Stress Corrosion Cracking (IASCC) of the BWR top guide structure. A finite element beam model of a particular top guide configuration was developed and top guide beam loads due to a design basis earthquake (the most challenging loading event) were calculated. Using material fracture toughness properties which reflect expected irradiation fluence gradients, critical crack sizes for different assumed crack locations and orientations were calculated. Irradiated stainless steel material properties were summarized and an assessment of the consequences of top guide cracking was also carried out. This study shows that rather large IASCC cracks could be developed in the BWR top guide before beam failure would be predicted. Further, it was reasoned that multiple beam failures would need to be shown as a credible failure mode for top guide IASCC to become a major safety issue.

11206 **(EPRI-NP—4768) Toughness of austenitic stainless steel pipe welds: Topical report.** Landes, J.D.; McCabe, D.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1986. 102p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920136.

The objectives of the program were to characterize the toughness of austenitic base and weld metals, and to evaluate the application of elastic-plastic fracture mechanics testing methodologies, developed for ferritic steels, to very ductile austenitic steels. Submerged arc, shielded metal arc, and tungsten-inert gas weldments in the as-deposited condition were tested to determine fracture behavior, tensile properties, and Charpy toughness. Comparisons were made of test results using EPRI fracture handbook solutions to evaluate the reliability of the analysis methodology. Results show that weld metal is less tough than base metal, and that recommended ASTM toughness testing procedures were inappropriate for ductile stainless steels. The study gave direction to a revision

for flaw evaluation of flux weldments in IWB-3640 of Section XI of the ASME Code.

11207 (EPRI-NP—4769-SR, pp 1.3-1.17) **Role of microprocessor systems in power plant control, monitoring, and safety.** Divakaruni, S.M. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The digital computer field is an example of new technology that advanced at a phenomenal rate in the last decade. Most utilities have realized the benefits this new technology can offer, and in 1983 alone the utility industry spent $2 billion in purchase of new computer hardware equipment. The major benefit from the digital technology, however, will be realized in the US power plants, when the major plant control and protection functions are performed using the high reliability microprocessor systems. Unlike the monitoring applications, the plant control function replacements will have to be handled rather cautiously and the utility acceptance of these systems will be time-consuming. The major reasons for this delay are discussed. The benefits of digital central systems are described.

11208 **(EPRI-NP—4883M) Evaluation of flawed-pipe experiments: Final report.** Zahoor, A.; Gamble, R.M. (NOVETECH Corp., Rockville, MD (USA)). Nov 1986. 48p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920139.

The purpose of this work was to perform elastic plastic fracture mechanics evaluations of experimental data that have become available from the NRC Degraded Pipe Program, Phase II (DPII) and other NRC and EPRI sponsored programs. These evaluations were used to assess flaw evaluation procedures for austenitic and ferritic steel piping. The results also have application to leak before break fracture mechanics analysis. An improved relationship was developed for computing the J-Integral for pipes containing throughwall flaws and loaded in pure bending. The results from several DPII experiments were compared to predictions based on new J estimation scheme solutions for circumferential, finite length part-throughwall flaws in pipes with bending loading. Comparisons of experimental maximum loads with those predicted using procedures in Paragraph IWB-3640, Section XI of the ASME Code indicate that the Code flaw evaluation procedures and allowables for austenitic steel pipe are appropriate and conservative. However, the comparisons also indicate that the base metal Code allowable loads may be about 15 to 20% high for small diameter piping (less than 8-inch diameter) at allowable a/t larger than about 0.5. The work further indicates that there is justification for reducing the conservatism in IWB-3640 allowable flaw sizes and loads for austenitic steel pipe with submerged or shielded metal arc welds.

11209 (IWGFPT—24, pp 38-42) **In-reactor corrosion data on fragema fuel.** Thomazet, J.; Ravier, G.; Houdaille, B.; Billot, P.; Lavoine, O.P. (Fragema, Lyon, France). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

For the past few years increased NSSS and fuel performance has been analyzed. Fuel discharge burnup has been increased to improve fuel utilization. New operating strategies such as load follow, frequency controls or enhanced NSSS performance by increased reactor coolant temperature have been introduced. The outcome for the fuel is increased residence time, higher wall temperatures and a more aggressive thermal/hydraulic environment with nucleate boiling at the lead rod locations. All these factors aggravate oxidation. To improve knowledge of standard cladding corrosion limits, a number of fuel surveillance programs have been set up. At the same time analytical loop tests have been performed. The results and initial conclusions are given.

11210 (IWGFPT—24, pp 46-53) **Evaluation of and improvements in the performance of zircaloy cladding during and after its residence in water cooled nuclear power reactors.** Venkateswarlu, K.S.; Venkateswaran, G. (Bhabha Atomic Research Centre, Bombay, India). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

External cladding corrosion during operation of a boiling water reactor, as well as during the prolonged storage of irradiated fuel elements in away from reactor spent fuel pools has been discussed. With dissolved oxygen in feed water being controlled to 10 to 15 ppb, the input of total metals to the reactor core is reduced to a level of 1 to 2 ppb. Despite this, some loss in clad integrity of fuel elements has been noted. A detailed analysis of the data over the last 15 years indicated no correlation between input of corrosion products (total metals in feed water) and loss in clad integrity. Similarly the distribution of system corrosion products in the circulating coolant crud and the fuel surface, did not show any effect on the clad corrosion. Surface treatment of Zircaloy has been modified so as to eliminate pickling and autoclaving so that there is no contamination with fluoride. The uptake of hydrogen by Zircaloy-4 under static conditions appeared to saturate fairly quickly (in about 60 days). It is shown that prolonged storage of irradiated fuel elements in spent fuel pools did not result in any noticeable increase in the clad corrosion. Such investigations are considered to be complementary to in-pile corrosion of Zircaloy on the water side and a better understanding of the external cladding corrosion during power operation can be gained by a total approach to data gathering and interpretation.

11211 (IWGFPT—24, pp 53-65) **Influence of second phase particles on the nodular corrosion of Zircaloy-2.** Pettersson, K.; Bergqvist, H. (Studsvik Energiteknik AB, Nykoeping, Sweden). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Recent development of Zircaloy cladding tubes for Boiling Water Reactors has resulted in a new generation of cladding tubes which have superior in-pile corrosion properties in comparison with current standard cladding. The improvement in corrosion properties is a result of thermo-mechanical processing steps during tube production which produce a finely dispersed distribution of second phase particles. In order to achieve a better understanding of the mechanism by which the particle distribution influences the corrosion behavior authors have studied five different Zircaloy-2 variants with significantly different second phase particle distributions. The differences in particle distributions were produced by varying the heat treatments before the final processing steps. Thus all five variants had almost identical grain structures and textures, only the second phase particle distributions and, possibly, the matrix content of alloying elements were different between the materials. The differences in corrosion behavior were evaluated with the high temperature steam test (500-510°C) which has been shown to correlate well with BWR corrosion behavior. The main part of the work was a characterization of the structures of the five materials and a few of the properties of oxides grown on the materials.

11212 (IWGFPT—24, pp 66-69) **Long time out of pile corrosion of Zircaloy-4 in 350°C water.** Garzarolli, F.; Pohlmeyer, I.; Steinberg, E.; Trapp-Pritsching, S. (Kraftwerk Union AG, Erlangen, West Germany). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

A transition in corrosion kinetics from an approximately cubic to an almost linear time dependency occurs after 60 to 180 days. Linear post-transition corrosion rate is between 0.18 and 0.45 $mg/dm^2.d$ for material from usual fabrication routines. The major reason for variations in the corrosion is the yield strength. However, some effect is also due to β-quenching and -annealing. The surface finish influences only the time to transition. The objective of

these tests was to determine the long time out-of-pile corrosion behavior, the lot-to-lot variation in the corrosion behavior of the as-received tubing, the effect of surface treatment, and the influence of various temperature treatments. (1) Surface treatment: pickled, electropolished, ground. (2) Cold work in the final step and final annealing: 40, 60 and 80 % CW, SR (450- 500 °C), PR (500 - 550 °C), RX (550 - 600 °C). (3) (α + β), β-Treatment with and without subsequent -annealing: 875 °C, 990 °C, 1075 °C and 1150 °C / 100 K/s - treatment, 470 °C, 600 °C, 700 °C, 750 °C, 800 °C and 850 °C annealing, 0.3, 5, 50 and 500 K/s quenching from 1050 °K.

11213 (IWGFPT—24, pp 81-90) **Justification of in-plant waterside corrosion of Zircaloy clad on the basis of thermal and hydraulic calculations.** Billot, P.; Beslu, P.; Frejaville, G. (CEA, Centre d'etudes nucleaires de Cadarache, Saint-Paul-lez-Durance, France). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Up to now, corrosion rate models have been developed to describe pre-and-post transition kinetics and calculate oxide layer thickness at transition. Correlations show dependencies on variable such as: time, temperature, neutron flux, heat flux, crud and oxide conductivities. Correlations are empirical and not phenomenological (autoclave and in-reactor measurements have been collected to develop these correlations). However, in the review of corrosion data measured on the fuel rods of different reactors, the conclusion is that oxide layer thickness shows an important scatter compared with ex-reactor tests (and consequently with models). This results from the fact that the environment of a reactor is much more complex than that of an autoclave. For it is apparent that all factors influencing the corrosion of Zircaloy fuel rods are not often precisely known.

11214 (IWGFPT—24, pp 94-98) **Effect of impurity elements on corrosion behavior of Zircaloy in high temperature steam.** Das, M. (Dept. of Atomic Energy, Bombay, India). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Lot to lot variation in chemical composition, impurity levels, alloying elements and mechanical properties may be found in the manufacture of Zircaloy cladding tube materials. These have effect on the corrosion behavior. Long term out-of-pile corrosion tests were conducted to study the effect of impurity elements (e.g. Aluminium, Nitrogen) on corrosion behavior. It was observed that short term tests (3 days or 14 days) did not reveal the effect of impurity elements on corrosion behavior. The effect is revealed only in the longer term (after about 200 days). The transition in corrosion kinetics was found to occur after about 100 days. Further studies are recommended to clarify the effect of chemical composition and impurity levels on the corrosion behavior. The usefulness of short term test needs to be evaluated.

11215 (IWGFPT—24, pp 113-117) **Corrosion products release from steel surface into BWR water coolant.** Kritsky, V.G.; Korolev, A.S.; Berezina, I.G.; Sofyin, M.V. (All-Union Scientific Research and Planning Institute of Complex Power, Leningrad, USSR). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Factors influencing steel corrosion product release and transfer into a BWR primary circuit have been studied and reported on in this paper. The study of corrosion kinetics and corrosion product release was carried out on the samples tested under RBMK NPP condensate-feedwater cycle conditions, as well as, under test rig conditions. The ratio of corrosion product specific mass, transferred to the water, to the whole corrosion product specific mass of steel, formed under the given conditions was determined and used as a criterion, characterizing the extent of corrosion product transfer from the steel surface into the water.

11216 (IWGFPT—24, pp 117-126) **In cell measurements of crud and corrosion of BWR and HWR fuels at reef, JAERI.** Yamaki, J.; Sakakura, A.; Kodama, T. (Japan Atomic Energy Research Institute, Ibaraki-ken, Japan). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Post-irradiation examinations of fuel assemblies of the water power reactors have been executed since Dec. 1979 at the Reactor Fuel Examination Facility, in Tokai Research Establishment JAERI. The crud was investigated for two Tsuruga fuel assemblies (BWR type; 21,300MWd/t and 22,000MWd/t average burn-up) and Fugen fuel assembly (heavy water moderated and light water cooled reactor; 13,600MWd/t), and also the nodular corrosions were especially investigated for the Tsuruga fuels. The crud was visually observed and examined closely under the dry condition of fuel assembly in the hot cell. The thickness of the crud at the really same position of the assembly was determined as the difference of rod-rod gaps before and after removing crud. The distribution of the thickness along the whole length of assembly was obtained by applying this method, too. The nodular corrosions in the fuel rod were visually observed and detected by the non-destructive profilometry. The nodular corrosions are more likely to grow up on the corresponding rod-surface of pellet interface. On the other side, as the destructive examination, the nodular corrosions were investigated microscopically, and their thickness were measured on the transverse cross section of fuel rod. The vertical distribution in the thickness of nodular corrosion was obtained and the maximum value was about 100 microns in the case of Tsuruga fuel rod.

11217 (NUREG/CR—4806) **Analysis of cracks in stainless steel TIG [tungsten inert gas] welds.** Nakagaki, M.; Marschall, C.; Brust, F. (Battelle Columbus Labs., OH (USA)). Dec 1986. 68p. (BMI—2144). NTIS, PC A04/MF A01 - GPO. File Number TI87900393.

This report contains the results of a combined experimental and analytical study of ductile crack growth in tungsten inert gas (TIG) weldments of austenitic stainless steel specimens. The substantially greater yield strength of the weld metal relative to the base metal causes more plastic deformation in the base metal adjacent to the weld than in the weld metal. Accordingly, the analytical studies focused on the stress-strain interaction between the crack tip and the weld/base-metal interface. Experimental work involved tests using compact (tension) specimens of three different sizes and pipe bend experiments. The compact specimens were machined from a TIG weldment in Type 304 stainless steel plate. The pipe specimens were also TIG welded using the same welding procedures. Elastic-plastic finite element methods were used to model the experiments. In addition to the J-integral, different crack-tip integral parameters such as $\Delta T/sub\ p/*$ and J were evaluated. Also, engineering J-estimation methods were employed to predict the load-carrying capacity of the welded pipe with a circumferential through-wall crack under bending.

11218 (WCAP—11185) **A study of the effects of preventive maintenance and test on nuclear plant availability.** Engel, R.J.; Kitzmiller, J.T.; McCutchan, D.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Systems Div.). Jun 1986. Contract AC02-85CH10220. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87004005.

The purpose of this study is to investigate the effect of selected maintenance, operations, and organizational factors in the management of nuclear power stations. The fundamental criteria used throughout the study in making the determination between good and bad practices is the effect on unit availability.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 10936, 11207, 11208, 11209, 11212, 11213, 11217, 11218, 11270, 11277, 11279, 11285, 11286, 11287, 11288, 11329, 11330, 11332, 11334, 11335, 11336, 11337, 11338, 11339, 11340, 11341, 11342, 11343, 11345, 11346, 11348, 11349, 11350, 11351, 11352, 11353, 11354, 11357, 11358, 11359, 11361, 11362, 11363, 11364, 11365, 11366, 11367, 11368, 11370, 11371, 11377, 11378, 11379, 11380, 11388, 11399, 11402, 11403, 11404, 11406, 11412, 11413, 11414, 11624

11219 **(BNL-NUREG—38841) Trial application of reliability technology to emergency diesel generators at the Trojan Nuclear Power Plant.** Wong, S.M.; Boccio, J.L.; Karimian, S.; Azarm, M.A.; Carbonaro, J.; DeMoss, G. (Brookhaven National Lab., Upton, NY (USA); Science Applications International Corp., McLean, VA (USA)). 1986. Contract AC02-76CH00016. 7p. (CONF-860908—34). NTIS, PC A02/MF A01 - GPO. File Number TI87002585.

From Operability of nuclear power systems in normal and adverse environments meeting; Albuquerque, NM, USA (29 Sep 1986).

In this paper, a trial application of reliability technology to the emergency diesel generator system at the Trojan Nuclear Power Plant is presented. An approach for formulating a reliability program plan for this system is being developed. The trial application has shown that a reliability program process, using risk- and reliability-based techniques, can be interwoven into current plant operational activities to help in controlling, analyzing, and predicting faults that can challenge safety systems. With the cooperation of the utility, Portland General Electric Co., this reliability program can eventually be implemented at Trojan to track its effectiveness.

11220 **(EPRI-NP—4904) Calvert Cliffs Unit 1 tube examination: Final report.** McInteer, W.A. (Babcock and Wilcox Co., Lynchburg, VA (USA). Lynchburg Research Center; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 83p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920174.

Two tube samples were removed from a Calvert Cliffs Unit No. 1 steam generator tube (Serial No. L61-R96) for a laboratory examination at B & W's Lynchburg Research Center. The tube samples contained several shallow, low voltage OD indications that were detected in scattered locations during the EOC-6 outage eddy current inspection. The purpose of the examination was to identify the source of shallow, OD indications on these tube pieces.

11221 **(EPRI-NP—4955) Comparison of QUANDRY and PDQ analysis of Zion Unit 2, Cycle 1: Final report.** Rempe, K.R.; Henry, A.F. (Massachusetts Inst. of Tech., Cambridge (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 117p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920180.

The two-group nodal code QUANDRY is evaluated by comparison with a define-mesh, two-group, two-dimensional, quarter-core PDQ simulation of cycle-1 of the ZION-2 reactor. Maximum error in assembly power during the cycle is 4.4% and computed k/sub eff/ values drift by 0.5%. These larger than normal errors are attributed to corresponding errors in node-averaged cross sections obtained from color set computations.

11222 (IHZ-WIK—85-533/601/2, pp 27-30) **Use of niobium for accurate relative fast neutron fluence measurements at the pressure vessel in a WWER-440 NPP.** Baers, B. (Technical Research Centre of Finland, Reactor Laboratory Otakaari 3A, Espoo). 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780051. (CONF-8504237—Pt.2).

From 7. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (16 Apr 1985).

The reaction ^{93}Nb (n,n') /sup 93m/Nb, with low threshold energy (approximately 0.9 MeV) was used in a novel way to obtain both absolute and accurate, relative experimental estimates for the fast neutron (threshold) fluence at the inner wall of the pressure vessel (PV) in a WWER-440 type PWR reactor. Niobium was separated using chemical methods from steel samples containing 0.5...1% niobium, which had been scraped from the inner wall of the Loviisa NPP. Irradiated niobium foils from the surveillance chains (SC) were also treated in a similar way. Niobium from the liquid samples was then electro-deposited in very thin layers on copper discs. The amount of niobium deposited was determined by spectrophotometry and liquid scintillation measurements. The accuracy of the mass determination was further checked by an additional and independent method. The absolute activity of the niobium deposits was determined by measuring the 16.6 and 18.6 keV X-ray emission with a calibrated Si(Li) detector. The threshold flux PHI/ sub T/ (> 0.9 MeV) was then obtained. The results indicate that the relative fluence estimates (PV/SC), which are sufficient for relating the measured embrittlement of the SC steel samples to the embrittlement of the PV, can be obtained with many times reduced in-accuracy (from tens of per cent to less than ten per cent) as compared to separate absolute estimates and estimate obtained by normalizing the calculated fluxes to conform with the measured results at the SC.

11223 (IHZ-WIK—85-533/601/2, pp 45-49) **Contribution for the determination of dependences between sub-assembly, hoisting device utilization and scheduling (presented for the main building of nuclear power plants with WWER-1000 type reactors).** Steinkopf, C.J. (Ingenieurhochschule Zittau, German Democratic Republic. Sektion Kraftwerksanlagen und Energieumwandlung). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780051. (CONF-8504237—Pt.2).

From 7. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (16 Apr 1985).

The correlations between assembly problems, sub-assembly, hoisting device utilization, manpower planning and scheduling are presented for the main building of nuclear power plants with WWER-1000 type reactors. The degree of sub-assembly should be increased by improving construction and assembly technology in order to reduce the assembling time and to influence the manpower concentration. For it powerful erection cranes are used. The advantages of the recently developed erection crane MKZ 3000 are reported.

11224 (IWGFPT—24, pp 17-26) **Influence of thermal-hydraulic plant design parameters and power history on PWR cladding corrosion.** Zimmermann, R.; Eberle, R.; Fuchs, H.P.; Gross, H.; Wunderlich, F. (Kraftwerk Union Aktiengesellschaft, Erlangen, West Germany). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Parameter studies on PWR fuel rod water side corrosion have been performed. The analyses mainly covered the consequences of changes of core inlet temperature, mass flow rate and system pressure; additionally the effect of time variation of the rod power has been treated. The results clearly show that besides a general burnup dependence the oxide layer at discharge hinges upon the thermal-hydraulic design of the specific plant and on the power history of the individual rod. Due to the Arrhenius law for the corrosion rate the corrosion thickness is a non-linear function of the surface temperature of the cladding. A small increase of the core inlet temperature or a decrease of the mass flow rate may increase the oxide layer thickness at discharge by a considerable amount. Therefore, numbers for observed oxide layer thicknesses reported together with associated burnup values have to be interpreted on the basis of the individual rod power history and the thermal-hydraulic parameters of the specific plant. The corrosion thickness is monotonously increasing with burnup. Nevertheless it is not a unique function of this quantity. The details of the specific power history additionally control the EOL oxide film thickness to a great extent. Thus, it can happen that rods with equal burnups do not show comparative oxide thicknesses. This knowledge shows that core reshuffling optimization procedures which account for cladding corrosion offer the potential for reducing peak values of the oxide thicknesses.

11225 (IWGFPT—24, pp 27-37) **External cladding corrosion of B & W-designed PWR fuel rods through burnups of 50 GWD/MTU.** Pyecha, T.D.; Bain, G.M.; McInteer, W.A.; Pham, C.H. (Babcock & Wilcox Co., Lynchburg, VA). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

The Babcock and Wilcox Company, Duke Power Company, and the US Department of Energy are participating in a joint program to identify burnup-limiting concerns of current-design, Zircaloy-4 clad, pressurized water reactor (PWR) fuel rods to aid in qualifying current-design fuel for higher burnups and in developing advance-design fuels with extended-burnups capability. The nondestructive measurements of cladding oxide thickness is included in this program to extend the industry data base on in-reactor oxidation behavior to burnups of 50 GWd/mtU and to assess the potential concern of accelerated oxidation on the waterside of fuel rods under extended-burnup operating conditions. As a part of this program, five B & W - designed, 15 x 15, Mark-B assemblies were irradiated for four cycles in Duke Power Company's Oconee Unit 1 reactor (2568 MWth, PWR). This paper presents the results of these measurements. The trends observed in these examinations indicate that uniform waterside corrosion will not limit the routine operation of B & W current-design PWR fuel through burnups of 50 GWd/mtU. However, additional data beyond 50 GWd/mtU or under more severe operating conditions are needed to confidently project these trends to higher burnups.

11226 (IWGFPT—24, pp 43-46) **Problems of waterside corrosion of VVER clads.** Reshetnikov, F.G.; Bibilashvili, Yu.K.; Solyany, V.I. (All-Union Scientific and Research Institute of Inorganic Materials, Moscow, USSR). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

The results of out-of-pile tests of specimens and pilot fuel clad in Zr-1% NB and Zr-2.5% in some cases, carried out in research reactors MR, MIR and SM-2 are presented in the paper. The ways to reduce irradiation induced contamination of the primary reactor circuits are described. Corrosion of VVER claddings related to the load-following mode of operation is also discussed.

11227 (IWGFPT—24, pp 70-80) **Waterside corrosion of Zircaloy-4 in nucleate boiling conditions.** Noe, M.; Beslu, P.; Thomazet, J. (CEA, Centre d'etudes nucleaires de Cadarache, Saint-Paul-lez-Durance, France). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Crud deposition and clad corrosion have been studied in an out-of-pile loop, in conditions including nucleate boiling heat transfer. It has been shown that nucleate boiling with detached bubbles increased the deposition of corrosion products on the cladding. In case of heavy crud, the morphology changed with aging and consistent enrichment of the deposit with mineral impurity was determined. In nucleate boiling conditions with void fractions higher than 1 to 2%, there is an enhancement of clad corrosion, which cannot be explained on the basis of the thermal barriers to heat transfer. A test with high lithium (10 ppm Li) was carried-out and demonstrated that overconcentration of lithium ion was responsible for corrosion enhancement under nucleate boiling heat transfer.

11228 (IWGFPT—24, pp 90-94) **Experimental corrosion tests of Zr-Nb cladding material.** Kysela, J.; Hamerska, H.; Jindrich, K. (Nuclear Research Institute, Rez, Czechoslovakia). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

The paper summarizes results of experimental work carried out in NRI in the field of fuel cladding corrosion tests. This work was done under the contract with IAEA. Corrosion of fuel cladding material (zirconium alloy Zr-Nb) was done in an out-of-pile loop with parameters corresponding PWR primary circuit. The measurement of instantaneous corrosion rate of material was solved by application of remote electro-chemical methods. The test loop and extraction the relevant electrical signals from water environment with pressure up to 20 MPa and temperature up to 350°C are described. The dependency of corrosion rate of zirconium alloy 99% Zr 1% Nb on the temperature of water environment, boric acid concentration and oxygen content was investigated. From the measured corrosion rate it was possible to obtain a detailed information on the history of resulting increase of corrosion layer. Direct monitoring of corrosion process informs even of the temporal fluctuations of corrosion rate during the long term expositions. The corrosion rate value is compared with the published data.

11229 (IWGFPT—24, pp 99-106) **Crud build-up and migration processes in the primary coolant circuit of Nuclear Power Plant Kozlodui.** Kolev, S.T.; Dinov, K.A. Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Observations of some important problems concerning the crud activity build-up and migration processes in the primary coolant circuit of NPP Kozlodui are described. The influence of the main coolant thermohydraulic and physico-chemical parameters on the behavior of different corrosion products fractions is considered at steady-state and during transient operation. Experimental results show the predominant meaning of the disperse fraction ($d > 0.4$ μm) for activated corrosion product transfer. A comparison between the activity of basic activated crud in the coolant of different units 2 and 3 is made.

11230 (IWGFPT—24, pp 107-112) **Transfer of radioactive corrosion products in the primary circuit of the WWER-440.** Burclova, J.; Kapisovsky, V.; Duris, J.; Barta, O.; Kysela, J. (Research Institute of Nuclear Power Station, Jaslovske Bohunice, Czechoslovakia). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

Experience from the experimental monitoring of corrosion products migration in the primary circuit of the WWER 440 is described. Results of measurement of the activity level of corrosion products during the steady-state conditions and transients are presented. On the basis of the qualitative analysis of the experimental results predominant transfer processes of radioactive corrosion products are discussed.

11231 **(NUREG—1107-Add.) RCSLK9: Reactor coolant system leak rate determination for PWRs: User's guide: Installation procedures.** Kirkpatrick, D.C.; Woodruff, R.W.; Bell, P. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Emergency Preparedness and Engineering Response). Dec 1986. 8p. NTIS, PC A02/MF A01 - GPO. File Number TI87900320.

RCSLK9 is a computer program developed for use on the IBM PC to analyze the leak tightness of the primary coolant system for any pressurized water reactor. This Addendum to the original report, NUREG-1107, RCSLK9: Reactor Coolant System Leak Rate Determination for PWRs, User's Guide, was prepared to provide more detail regarding installation procedures. RCSLK9 was written to run with IBM Personal Computer DOS, Version 2.00 or 2.10, User's Guide contains the RCSLK9 application program but not the DOS or BASIC programs. For RCSLK9 to run properly a working diskette must be prepared for a two floppy drive IBM/PC or an IBM/XT.

11232 **Efficient numerical solution procedure for light water reactor core dynamics.** Wu, C.D. Cincinnati, OH; Univ. of Cincinnati (1986). 314p. University Microfilms Order No. 86-22,312.

Thesis (Ph. D.).

An efficient method for obtaining solutions of three-dimensional LWR core transients with void feedback was developed. A modified version of the so called adiabatic approach is used to solve the transient neutronic calculations. The effective multiplica-

tion factor obtained from the shape equation is used in the amplitude equation to predict the power level for the next time step. The partial convergence approach, which incorporates the thermal hydraulic and neutronic calculations in a single package and converges on both solutions simultaneously, is adapted to the transient computations. Due to flow channel geometry differences, the thermal hydraulic calculations are treated differently for PWR's and BWR's. A zero radial pressure gradient is assumed in order to solve for the flow redistribution among the open channels in a PWR. The quasi-static momentum integration method, along with the assumption a uniform pressure drop through the flow channels, is used to determine the inlet flow distribution in a BWR. This approach is believed to be a considerable improvement over methods previously available; it presents the simplicity of the adiabatic formulation while leading to an accuracy comparable to that of the usual quasi-static approach.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 11328, 11375, 11376

11233 **(GA-A—18633) The modular high-temperature gas-cooled reactor (MHTGR).** Neylan, A.J. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1986. Contract AC03-84SF11963. 17p. (CONF-8610160—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000915.

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The MHTGR is an advanced reactor concept being developed in the USA under a cooperative program involving the US Government, the nuclear industry and the utilities. The design utilizes basic HTGR features of ceramic fuel, helium coolant and a graphite moderator. However the specific size and configuration are selected to utilize the inherently safe characteristics associated with these standard features coupled with passive safety systems to provide a significantly higher margin of safety and investment protection than current generation reactors. Evacuation or sheltering of the public is not required. The major components of the nuclear steam supply, with special emphasis on the core, are described. Safety assessments of the concept are discussed.

11234 **Thermal hydraulic and neutronic interaction in the rotating bed reactor.** Lee, C.C. Troy, NY; Rensselaer Polytechnic Institute (1986). 304p. University Microfilms Order No. 86-19,987.

Thesis (Ph. D.).

Power transient characteristics in a rotating fluidized bed reactor (RBR) are investigated theoretically. A propellant flow perturbation is assumed to occur in an initially equilibrium state of the core. Transfer functions representing quasi-one-dimensional mutual feedback between thermal hydraulics and neutronics are developed and analyzed in the frequency domain. Neutronic responses are determined by Fermi-age theory for slowing down of fast neutrons and diffusion theory for thermal neutron distribution. Neutron leakage through the exhaust nozzle is accounted for by applying diffuse view factors similar to those applied in radiative heat transfer. The bed expansion behavior is described by a kinematic wave equation derived from the continuity of the gas phase. The drift flux approach is used to determine the yield fractions in the equilibrium bed. Thermal responses of fuel are evaluated by dividing it into several volume-averaged zones to better account for the transient effects over single zone models. Sample calculations are undertaken for the various operation conditions and design parameters of the RBR based on 250 MW/sub t/, 1000 MW/sub t/, and 5000 MW/sub t/ power reactors. The results show that power transients are dependent on the parametric changes of optical thickness and view factors.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 11214, 11216, 11267, 11268

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 10917, 11241, 11282, 11283, 11291, 11412

11235 (EPRI-NP—4769-SR, pp 2.21-2.29) **Application of a fault-tolerant microprocessor-based core-surveillance system in a German fast breeder reactor.** Voges, U. (Institut fur Datenverarveitung, Karlsruhe, West Germany). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

For the fast breeder reactor KNK II at Karlsruhe, Germany, a microprocessor-based safety shut-down system is built. Analogue to the triple modular instrumentation it consists of TMR hardware. Functionally it is split into four blocks which operate in cascade-like fashion. The main functions are mean value calculation, current limit control, trend control, and final evaluation. In order to secure correctness, several constructive and analytical methods are applied for fault avoidance, like formal specification languages, programming guidelines, software quality assurance plan, validation, verification, and testing. Since additional means for correct and safe operation are still necessary, fault-tolerance and error-detection techniques are applied. These include self-checking programs, plausibility checks, control data, information exchange and control between the redundancies, and especially diversity. This diversity refers to different teams for the different development phases as well as to different tools and environments, like different programming languages for the application software. Three separate but functional identical programs will be implemented in Iftran, Pascal and PL/M. These will not only be used during the extensive testing period, but also during final operation.

2107 Regulation And Licensing

11236 **(NUREG—0020-Vol.10-No.7) Licensed operating reactors: Status summary report data as of 06-30-86.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management). Nov 1986. 429p. NTIS, PC A19/MF A01 - GPO. File Number TI87900278.

This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

11237 **(NUREG—0386-Digest.4-Rev.3) United States Nuclear Regulatory Commission staff practice and procedure digest: Commission, Appeal Board, and Licensing Board decisions issued from July 1, 1972 through March 31, 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of the General Counsel). Oct 1986. 475p. NTIS, PC A20/MF A01 - GPO. File Number TI87900246.

A digest is given of a number of Commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period from July 1, 1972 to March 31, 1986, interpreting the NRC's Rules of Practice. Parts of earlier editions and supplements are replaced, and amendments to the Rules of Practice effective through March 31, 1986 are reflected. The material included deals with applications, prehearing matters, hearings, post-hearing matters, appeals, and decisions related to general matters. Decisions are indexed by facility, citation, CFR, statutes, case law, and other legal citations. (LEW)

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 11441

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 12749, 12830

11238 (CTA-IEAV-RP—020/85) Evaluation of angular integrals in the generation of transfer matrices for multigroup transport codes. Garcia, R.D.M. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 2 Oct 1985. 17p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700456.

The generalization of a semi-analytical technique for the evaluation of angular integrals that appear in the generation of elastic and discrete inelastic tranfer matrices for transport codes is carried out. In contrast to the generalized series expansions which are found to be too complex and thus of little practical value, when compared to the Gaussian quadrature technique, the recursion relations developed in this work are superior to the quadrature scheme, for those cases where the round-off error propagation is not significant.

11239 (HEDL-SA—3315-FP) Solid State Track Recorder fission rate measurements at high neutron fluence and high temperature. Ruddy, F.H.; Roberts, J.H.; Gold, R. (Hanford Engineering Development Lab., Richland, WA (USA)). 7 Jun 1985. Contract AC06-76FF02170. 10p. (CONF-850933—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87000248.

From 13. international conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1985).

Solid State Track Recorder (SSTR) techniques have been used to measure 239-Pu, 235-U, and 237-Np fission rates for total neutron fluences approaching 5 x 10^{17} n/cm^2 at temperatures in the range 680 to 830°F. Natural quartz crystal SSTRs were used to withstand the high temperature environment and ultra low-mass fissionable deposits of the three isotopes were required to yield scannable track densities at the high neutron fluences. The results of these high temperature, high neutron fluence measurements are reported.

11240 (JINR—R-11-85-309) Influence of the power reactivity effect on the power fluctuation in a pulsed reactor. The case of alternating reactivity oscillation. Shabalin, E.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700457.

Ratios between the amplitude of reversal oscillations of external reactivity in a pulsed reactor and power pulse energy oscillations with provision for temperature power reactivity effect are derived. The conclusion on the amplification of power oscillations for negative feed back is drawn. It is shown that at an verage power continuous power oscillations an arise also in the absence of external reactivity oscillations. The pulsed reactor can be in an equilibrium oritical state not only at a constant value of power pulse energy but also at variable energy values. 3 refs.; 3 figs.

11241 (UJV—7241-T) Automated mesh generation for fast reactor fuel assembly in calculating velocity and temperature fields by finite element method. Part 2. Schmid, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Aug 1985. 61p. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700458.

For Part I see UJV–6442-T (Feb 1983).

A modified set of programs is presented for mesh generation in the calculation of velocity and temperature fields of fast reactor fuel assemblies or their parts. The finite element method using a second order isoparametric triangular element was applied for mesh generation. The performance is described of the organizer including a detailed description of data selection, as is the program for connecting the grids into a resulting grid. Also given are auxiliary programs for the control of the generated grids (file print and grid plot) and one example of the practical use of the program. (Pu).

11242 Neutronic calculations for a new high flux reactor. Difilippo, F.C.; Worley, B.A.; Vondy, D.R. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 1399-1402 of Nuclear data for basic and applied science. Volume 2. Young, P.G.; Brown, R.E.; Auchampaugh, G.E.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The Oak Ridge National Laboratory has begun the design of a new high flux reactor to be used for basic research, isotope production, and material irradiation. One of the principal goals of the design is the production of a thermal flux peak in the reflector larger than 5 X 10/sup 15//cm/sup 2/sec. None of the existing steady sources of neutrons in the world produce such neutron flux. A theoretical analysis of the slowing-down and diffusion of neutrons produced by a spherical fission source immersed in a moderator shows that the flux per unit power is maximized by combining a very undermoderated core with a very low absorbing reflector. The theoretical model interrelates total power, power density and transport properties with the thermal flux allowing very inexpensive scoping calculations. Full scale and detailed calculations were made with a numerical model which uses the BOLD VENTURE code system. Calculations show that a highly enriched /sup 235/U reactor with D/sub 2/O as moderator and reflector would produce the desired peak flux, and the reactor would have a reasonable core life.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 11381, 11382, 11383, 11384, 11385, 11389, 11390, 11391, 11392, 11393, 11394, 11395, 11396, 11398

11243 (EGG-MS—6843-Rev.1) Weld energy reduction by using concurrent nondestructive evaluation: Final report. Johnson, J.A.; Carlson, N.M.; Watkins, A.D. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 60p. NTIS (US Sales Only), PC A04/MF A01; 1; GPO Dep. File Number DE87001898.

In-process inspection of partially completed welds is shown to be feasible and to have the potential of large economic and productivity improvements in certain circumstances. Ultrasonic inspection of the weld and analysis by an automatic pattern-recognition system has a flaw detection rate of 90 to 95% with a false call rate of about 8%. The pattern-recognition system uses cues that human observers use to discriminate between good and flawed weld. The system has the potential to discriminate among types of flaws. An application analysis shows a potential savings of over $21 per foot of weld on two in. thick plates such as used for pressure vessel fabrication. 5 refs., 15 figs., 8 tabs.

11244 (EPRI-NP—4888) Investigation of ASME code: Section 3, Subsection NB, Suggested revisions: Final report. Love, J.E. (Reedy Associates, Inc., Los Gatos, CA (USA)). Nov 1986. 56p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920138.

The nuclear industry has become increasingly aware that engineering standards documents include requirements which are technically inconsistent and in many cases excessively costly to apply. As a result of these concerns, a study of Subsection NB of Section III of the ASME Code was undertaken. Subsection NB addresses Code requirements for Class 1 Components for nuclear power plants. The study was restricted to one subsection with the intent of discovering the extent of the difficulties in the Code. The areas of primary concern were those requirements which have a direct impact on design, fabrication, and examination. Subsection NB was carefully reviewed for inconsistencies and unworkable criteria. Seventy-seven such deficiencies were identified. A preliminary recommendation was prepared for each inconsistency or unworkable criterion. An overall critique of the Subsection was written, and suggestions were made for addressing the problems as part of a major Code revision.

11245 **(EPRI-NP—4928) Assessment of ASME code Section 11 ultrasonic testing techniques: Final report.** Taylor, J.A. (Combustion Engineering, Inc., Chattanooga, TN (USA)). Nov 1986. 68p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920137.

A block representative of a nuclear component has been welded containing intentional defects. Acoustic emission data taken during the welding correlate well with ultrasonic data. Repetitive ultrasonic examinations have been performed by skilled operators using a procedure based on that described in ASME Section XI. These examinations were performed by different examination teams using different ultrasonic equipment in such a manner that the effects on the repeatability of the ultrasonic test method caused by the operator and by the use of different equipment could be estimated. It was tentatively concluded that when considering a large number of inspections: (1) there is no significant difference in indication sizing between operators, and (2) there is a significant difference in amplitude and defect sizing when Code acceptable instruments having different band widths are used. It was determined that the Section XI sizing parameters follow a bivariate normal distribution. Data derived from ultrasonically and physically sizing indication in nuclear components during fabrication show that the Section XI technique tends to overestimate the size of the reflectors. This report describes only the activities related to destructive evaluation of flaws 61 and 62.

11246 **(IHZ-WIK—85-533/601/2, pp 1-5) Plant diagnostics in power stations.** Sturm, A.; Doering, D. (Ingenieurhochschule Zittau, German Democratic Republic; Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780051. (CONF-8504237—Pt.2).

From 7. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (16 Apr 1985).

The method of noise diagnostics is dealt with as a part of plant diagnostics in nuclear power stations. The following special applications are presented: (1) The modular noise diagnostics system is used for monitoring primary coolant circuits and detecting abnormal processes due to mechanical vibrations, loose parts or leaks. (2) The diagnostics of machines and plants with antifriction bearings is based on bearing vibration measurements. (3) The measurement of the friction moment by means of acoustic emission analysis is used for evaluating the operational state of slide bearings.

11247 **(NUCLEBRAS-CDTN—488) Nuclebras' installations for performance tests of nuclear power plants components.** Vasconcelos Paiva, I.P. de; Avelar Esteves, F. de; Horta, J.A.L.; Resende, M.F.R.; Pinheiro, R.B. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 18 Dec 1984. 13p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700459.

The reasons for Nuclebras' Nuclear Technology Development Center to implement a laboratory for supporting Brazilian manufactures, giving to them the means for performing functional tests of industrial products, are presented. A brief description of facilities under construction: the components Test Loop and Facility for Testing N.P.P. components under Accident conditions, and other already in operation, as well as its objectives and main technical characteristics. Some test results had already obtained are also presented.

11248 (NUREG/CP—0065, pp 1-12) **Status of structural and mechanical engineering research at the US Nuclear Regulatory Commission.** Browzin, B.S.; Richardson, J.E. Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Research conducted by the NRC office of Nuclear Regulatory Research in Structural, Material, and Mechanical Engineering for light-water reactor nuclear power plants is reported. The list of projects and description of objectives include new initiates and ongoing efforts reported at the Seventh International Conference on Structural Mechanics in Reactor Technology held in Chicago in 1983.

11249 (NUREG/CP—0065, pp 13-49) **US Nuclear Regulatory Commission Seismic Safety Research Program.** Kenneally, R.M.; Richardson, J.E.; Murphy, A.J. Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

The Seismic Safety Research Program sponsored by the USNRC and carried out by various contractors is described. The seismic safety issues and program objectives to resolve these issues are discussed. The individual projects that make up the program are described in terms of scope and relationships with other projects and programs.

11250 (NUREG/CP—0065, pp 50-80) **NRC Seismic Design Margins Program Plan.** Cummings, G.E.; Johnson, J.J.; Budnitz, R.J. (Lawrence Livermore National Lab., CA). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Recent studies estimate that seismically induced core melt comes mainly from earthquakes in the peak ground acceleration range from 2 to 4 times the safe shutdown earthquake (SSE) acceleration used in plant design. However, from the licensing perspective of the US Nuclear Regulatory Commission, there is a continuing need for consideration of the inherent quantitative seismic margins because of, among other things, the changing perceptions of the seismic hazard. A Seismic Design Margins Program Plan, developed under the auspices of the US NRC, that provides the technical basis for assessing the significance of design margins in terms of overall plant safety is discussed. The Plan also identifies potential weaknesses that might have to be addressed, and recommends technical methods for assessing margins at existing plants. For the purposes of this program, a general definition of seismic design margin is expressed in terms of how much larger that the design basis earthquake an earthquake must be to compromise plant safety. In this context, margin needs to be determined at the plant, system/function, structure, and component levels.

11251 (NUREG/CP—0065, pp 81-91) **Latest results from the Seismic Category I Structures Program.** Bennett, J.G.; Dove, R.C.; Dunwoody, W.E.; Farrar, C. Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

With the use of scale and different size models, the Seismic Category I Structures Program has demonstrated consistent results for measured values of stiffness at working loads. Furthermore, the values are well below the theoretical stiffnesses calculated from an uncracked strength-of-materials approach. The scale model structures, which are also models of each other, have demonstrated scalability between models. The current effort is to demonstrate that the use of microconcrete and other modeling effects do not introduce significant distortions that could drastically change conclusions regarding prototype behavior for these very stiff, shear dominated structures.

11252 (NUREG/CP—0065, pp 92-103) **Equipment fragility testing.** Holman, G.S.; Chou, C.K.; Cummings, G.E. (Lawrence Livermore National Lab., CA). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Current probabilistic risk assessment (PRA) methods for nuclear power plants utilize component fragilities which are for the most part based on a limited data base and engineering judgement. The seismic design of components is based on code limits and NRC requirements that do not reflect the actual capacity of a component to resist failure. In order to improve the present component fragility data base and establish component seismic design margins, the NRC has commissioned a projected three-year program to compile existing fragilities data and at the same time independently perform fragilities tests on selected mechanical and electrical components.

The planning and technical approach being taken by LLNL in the NRC Component Fragility Program are discussed.

11253 (NUREG/CP—0065, pp 104) **Seismic fragility data for nuclear power plant equipment.** Hofmayer, C.H.; Bandyopadhyay, K.K. (Brookhaven National Lab., Upton, NY). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Traditionally, safety equipment for nuclear power plants are seismically qualified to specified requirement levels through proof testing or other similar methods of generic qualification. In recent years, as a result of increasing seismic requirements and uncertainties in the results of probabilistic risk assessments, there has been a greater need to understand the fragility levels of safety equipment. To date, qualitative estimates of fragility levels have been based primarily on engineering judgment and extrapolation of some available qualification data. As part of a recent component fragility research program sponsored by the US Nuclear Regulatory Commission, Brookhaven National Laboratory is involved in establishing seismic fragility levels for various equipment by identifying, collecting and subsequently analyzing capacity and fragility test data from various sources. The scope of this research program is described, the success in this regard to date is discussed, and the technical challenges in this task delineated.

11254 (NUREG/CP—0065, pp 105-134) **Dynamic fragility concepts for equipment design and qualification.** Kana, D.D.; Pomerening, D.J. (Southwest Research Institute, San Antonio, TX). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Fragility concepts are explored for use in design and qualification of nuclear plant equipment, and for relating equipment ultimate capability to that of the overall plant. In the most general sense, the fragility level of a device may depend on several different types of environmental stress or challenge factors, (i.e., heat, nuclear radiation, vibration, etc.) that influence its operation. However, emphasis is concentrated on the dynamic, and particularly seismic fragility levels of equipment. A general definition of dynamic fragility and various methods for its measurement are described. The state of published data on nuclear equipment fragility is discussed, and limitations on its use are noted. From there, the concept of a standardized seismic fragility data base and its potential uses are considered. Various gaps in the methodology are identified, and recommendations for further research are suggested.

11255 (NUREG/CP—0065, pp 135-183) **Seismic fragility of reinforced concrete structures in nuclear facilities.** Gergely, P. (Cornell Univ., Ithaca, NY). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

The failure and fragility analyses of reinforced concrete structures and elements in nuclear reactor facilities within the Seismic Safety Margins Research Program (SSMRP) at the Lawrence Livermore National Laboratory are evaluated. Uncertainties in material modeling, behavior of low shear walls, and seismic risk assessment for nonlinear response receive special attention. Problems with ductility-based spectral deamplification and prediction of the stiffness of reinforced concrete walls at low stress levels are examined. It is recommended to use relatively low damping values in connection with ductility-based response reductions. The study of static nonlinear force-deflection curves is advocated for better nonlinear dynamic response predictions.

11256 (NUREG/CP—0065, pp 184) **U.S.N.R.C. Containment Performance Research Program.** von Riesemann, W.A.; Costello, J.F. (Sandia National Labs., Albuquerque, NM). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

The major source of risk to the public from the operation of nuclear power plants stems from accident scenarios that lead to a containment failure. The regulatory concern is that the failure modes and associated load levels for containment structures cannot be predicted with any real confidence by state-of-the-art methods. This is especially so if the contemplated failure mode is localized leakage. Both assessments of the risk posed by loads outside the design basis and estimates of the effectiveness of proposed mitigative steps require an ability to predict the way in which a containment will fail. USNRC research on containment failure is based on the observation that excessive leakage can occur from four sources: (1) failure of the shell; (2) leakage at large penetrations; (3) leakage at electrical penetrations; and (4) leakage through valves.

11257 (NUREG/CP—0065, pp 185-195) **Pressure testing of large scale torispherical heads subject to knuckle buckling.** Miller, C.D.; Grove, R.B.; Bennett, J.G. (CBI Industries, Inc., Plainfield, IL). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Two fabricated steel torispherical heads were tested under internal pressure to determine their buckling and rupture strengths. Both models had cylindrical diameters of 192 in., knuckle radii of 32.64 in., sphere radii of 172.8 in. and measured thicknesses of 0.196 (Model 1) and 0.270 (Model 2). For Model 1, initial buckling was noted at 58 psi. Pressurization was continued to rupture at 229 psi. During the test, 14 buckles formed and a maximum strain of 3.5% was recorded in the spherical portion of the model. For Model 2, initial buckling was noted at 106 psi. Pressurization was continued to rupture at 332 psi. During the test 14 buckles formed and maximum strains of 4.3 to 4.7% were recorded in the spherical portion of the model.

11258 (NUREG/CP—0065, pp 196-215) **Investigation of steel containment buckling from dynamic loads.** Butler, T.A.; Baker, W.E.; Bennett, J.G.; Babcock, C.D. (Los Alamos National Lab., NM). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Buckling of free-standing nuclear steel containment buildings from dynamic base excitation was investigated in a combined experimental/numerical program. A polycarbonate scale model of a containment building was excited with scaled earthquake transients and single-frequency harmonic transients to determine the peak base acceleration levels required to induce buckling. Buckling was identified using recorded signals from strain gages and accelerometers, with high-speed video records, and by audibility. Experimental results are compared with numerical results obtained using a freezing-in-time technique. The results are preliminary since several more tests are to be performed. However, the limited data obtained indicate that the freezing-in-time technique approximates the required acceleration levels reasonably well, although not conservatively. Additional experiments are described that will take containment asymmetries into account, as well as use instrumentation that will provide more accurate measures of the occurrence of buckling.

11259 (NUREG/CP—0065, pp 216-219) **Full-scale concrete containment wall tests results and implications.** Schultz, D.M.; Hanson, N.W.; Julien, J.T.; Russell, H.G. (Portland Cement Association, Skokie, IL). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Analytical modeling and structural testing of complex structures are important tools for defining structural behavior. Behavior of secondary containment structures for nuclear power plants under loadings including overpressurization is currently being redefined through analytical modeling techniques and physical testing. Both full-scale element tests and small-scale model tests are being used to provide data for verification and to aid in development of the analytical models. Both full- and small-scale model testing have inherent bounds that limit the practicality or usefulness of test results.

Large scale tests provide information using full-size materials and practical details. However, large scale tests are expensive. Small-scale tests, on the other hand, tend to be less expensive. In reinforced and prestressed concrete structures, modeling of structural details and materials may not give a true representation of full-scale structures. For this reason, a marriage of full- and small-scale testing is necessary. Full-scale testing can be used to indicate the details that must be modeled with extreme care in the small-scale models. Small-scale models can be used to determine the overall behavior. Full-scale tests of secondary containment structures to destruction have not yet been economically feasible or practical. Consequently, the full-scale testing has concentrated on elements of the containments. Full-scale elements allow full-size details to be used. However, it is not always possible to perfectly simulate the boundary conditions at the edge of the elements. Consequently, some approximations must be made in developing a practical test specimen.

11260 (NUREG/CP—0065, pp 220-255) **Seismic soil structure interaction: analysis and centrifuge model studies.** Finn, W.D.L.; Ledbetter, R.H.; Beratan, L.L. (Univ. of British Columbia, Vancouver). Jun 1985. NTIS, PC A12/MF A01 - GPO. File Number TI85901725. (CONF-850809—EXC.).

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

A method for non-linear dynamic effective stress analysis is introduced which is applicable to soil-structure interaction problems. Full interaction including slip between structure and foundation is taken into account and the major factors are included which must be considered when computing dynamic soil response. An experimental investigation was conducted using simulated earthquake tests on centrifuged geotechnical models in order to obtain prototype response data of foundation soils carrying both surface and embedded structures and to validate the dynamic effective stress analysis. Horizontal and vertical accelerations were measured at various points on structures and in the sand foundation. Seismically-induced pore water pressure changes were also measured at various locations in the foundation. Computer plots of the data were obtained while the centrifuge was in flight and representative samples are presented. The results show clearly the pronounced effect that increasing pore water pressures have on dynamic response. It is demonstrated that a coherent picture of dynamic response of soil-structure systems is provided by dynamic effective stress non-linear analysis. Based on preliminary results, it appears that the pore water pressure effects can be predicted.

11261 (NUREG/CR—4638/1) **Transient fire environment cable damageability test results: Phase 1.** Wheelis, W.T. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1986. Contract AC04-76DP00789. 93p. (SAND—86-0839/1). NTIS, PC A05/MF A01 - GPO. File Number TI87002999.

The results of a series of 13 cable tests using IEEE-383 qualified and unqualified cable are discussed in this report. The purpose of these tests was to determine cable damage response (as indicated by electrical failure) to transient fire environments (temperature vs time only). The major insights gained from these tests were that (1) cables terminated in a fire environment are more likely to fail; (2) cable geometry plays a significant role in determining if a cable will fail; (3) convective heat transfer, i.e., high air flow regions, leads to severe cable damage; and (4) based on simulated, air cooled down suppression, neither qualified nor unqualified cables would fail given the suppression actuation times and test profiles used in these tests. This assumes that suppression agents (e.g., water) do not cause damage.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 11373, 11374, 11990

11262 (AAEC/E—632) **Out-of-pile burnout experiments in a full-scale simulation of an irradiation rig in a HIFAR hollow fuel element facility.** Chapman, A.G.; Hargreaves, N.D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1986. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700460.

Flow measurement and burnout experiments were performed in an out-of-pile test rig which simulates the conditions of UO_2 irradiation rig in a hollow fuel element facility of the HIFAR reactor. One per cent of the coolant flow in the fuel element passed through the irradiation rig. A burnout heat flux of 90 W cm^{-2} was observed at the surface of an electrically-heated, dummy irradiation can. When the coolant flow rate in the irradiation rig was increased by a factor of 2.5, the burnout heat flux rose by 30 per cent to 117 W cm^{-2}. A simple modification to the supporting frame for the cans improved the burnout heat flux by 3 per cent at 1 per cent of the coolant flow, but enhanced it by 17 per cent at 2.5 per cent of the coolant flow. Of ten burnout events observed, eight were located upstream of the end of the heated length of the can. The burnout results form a self-consistent, credible set of data and provide a rational basis for the establishment of maximum permissible operating heat fluxes in irradiation rigs of the type simulated. Recommendations are made for the practical application of the results. 10 figs.

11263 (EPRI-EA—4857, pp 6.1-6.5) **Impact of exchange rates on the world uranium market.** Fulton, M.E.; Combs, G.F. Jr. (Univ. of Saskatchewan, Saskatoon). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

A preliminary analysis of the relationship between exchange rates and US uranium prices and product ion is presented. This analysis supplements the discussions on the broader topic of fuel prices, exchange rates and other international economic phenomena scheduled during the 1985 EPRI Fuel Supply Seminar. By varying exchange rate assumptions in the recently developed Uranium Market Model, estimates of the magnitude and timing of price and production effects were obtained. These effects do indeed appear to be large and have implications in procurement, fuel planning and commodity policy. While analysts may differ on details, the inescapable conclusion is that exchange rates matter a great deal in the uranium market. The case described is for a scenario of exchange rates with other currencies returning to their 1980 levels. A second case, an across the board weakening of the dollar by 25%, the results of which are somewhat less dramatic is also examined.

11264 **Apparatus for inspecting fuel elements.** Oakley, D.J.; Groves, O.J.; Kaiser, B.J. (to Dept. of Energy, Washington, DC). US Patent 4,626,401. 2 Dec 1986. Filed date 21 Dec 1984. v.p.

This patent describes an alpha monitor for inspecting nuclear fuel pins for contamination by detecting emission of alpha particles from contaminants present upon exterior surfaces of a fuel pin casing after the casing has been sealed; comprising: a structural framework having an upper beam and lower beam which are spaced apart and approximately parallel, with the length of the beams defining a longitudinal direction. The structural framework further has front and rear end pieces connecting the upper and lower beams in fixed relationship; means for singularly accepting fuel pins positioned laterally adjacent to the alpha monitor. The means for singularly accepting fuel pins has singulator cylinders mounted for rotation, the singulator cylinders each having a fuel pin recess on an exterior surface thereof which aligns with associated fuel pin recesses on other singulator cylinders. The means for singularly accepting fuel pins further has means for rotating the singulator cylinders to thereby transfer fuel pins into the alpha monitor one at a time; and a first roller assembly connected to the lower beam for receiving fuel pins accepted by the means for singularly accepting fuel pins, the first roller assembly being arranged to roll fuel pins longitudinally to and from the alpha monitor for processing outside the alpha monitor; the first roller assembly including a plurality of first rollers and means for rotating the rollers to thereby convey the fuel pins longitudinally to and from the alpha monitor.

2204 Control Systems

REFER ALSO TO CITATION(S) 11246, 11334, 11335, 11336, 11337, 11338, 11339, 11340, 11341, 11342, 11343, 11344, 11345, 11346, 11347, 11348, 11349, 11351, 11352, 11353, 11354, 11355, 11356, 11357, 11358, 11359, 11360, 11361, 11362, 11363, 11364, 11365, 11366, 11367, 11368, 11369

11265 (EPRI-NP—4769-SR, pp 1.63-1.70) **Problems, issues and techniques in validating a fault tolerant system for reactor control.** Wensley, J.H. (August Systems Inc., Tigard, OR). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Nuclear reactor control systems and many other safety related systems, have reliability requirements that can only be met by fault tolerant systems. While there are commercially available systems that are, or claim to be, fault tolerant, it is necessary to validate that this is indeed true. This raises the issue of whether the analysis that is used to predict the reliability properly reflects the actual system. Another issue is whether the installed system agrees with the design. This includes both hardware and software questions and includes topics such as quality assurance, testing, etc. Techniques are described to address these issues. The research that is needed to advance these techniques to the point of practical utility is outlined.

11266 (EPRI-NP—4769-SR, pp 2.3-2.17) **CEGB philosophy and experience with fault-tolerant micro-computer application for power plant controls.** Clinch, D.A.L. (CEGB-Station Design Dept., Barnwood, England). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

From the mid-1960s until the late 1970s, automatic modulating control of the main boiler plant on CEGB fossil-fired power stations was largely implemented with hard wired electronic equipment. Mid-way through this period, the CEGB formulated a set of design requirements for this type of equipment; these laid particular emphasis on the fault tolerance of a control system and specified the nature of the interfaces with a control desk and with plant regulators. However, the automatic control of an Advanced Gas Cooled Reactor (AGR) is based upon measured values which are derived by processing a large number of thermocouple signals. This is more readily implemented digitally than with hard-wired equipment. Essential to the operation of an AGR power station is a data processing (DP) computer for monitoring the plant; so the first group of AGR power stations, designed in the 1960s, employed their DP computers for modulating control. Since the late 1970s, automatic modulating control of major plants, for new power stations and for re-fits on established power stations, has been implemented with micro-computers. Wherever practicable, the policy formulated earlier for hard-wired equipment has been retained, particularly in respect of the interfaces. This policy forms the foundation of the fault tolerance of these micro-computer systems.

11267 (EPRI-NP—4769-SR, pp 2.75-2.94) **Computerized plant protection systems in CANDU reactors.** Gilbert, R.S.; Hepburn, G.A.; Ichiyen, N.M. (Atomic Energy of Canada, Mississauga, Ontario). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The application of computers in CANDU plant protection systems is described. In CANDU reactors there are two plant protection systems and these are referred to as the reactor shutdown (or SDS) systems. Some major characteristics of these shutdown systems are discussed along with the hardware and software of computer systems which have been used to monitor SDS systems or to initiate reactor shutdowns. The hardware, the software and the licensing environment associated with a fully computerized shutdown system that is currently being designed are described. This latter system is expected to enter service in 1987.

11268 (EPRI-NP—4769-SR, pp 2.97-2.114) **Canadian nuclear power plant computer control and the application of microprocessors.** Whittal, W.R.; Hepburn, G.A. (Atomic Energy of Canada Ltd., Mississauga, Ontario). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Dual computer control systems are used for direct digital control of reactivity and other major process parameters in 27 full size commercial CANDU nuclear units, 16 of which are in-service. The control computers are also used for supervisory control, alarm annunciation on CRT displays, and graphic data presentation on CRT displays. The first dual computer control system for a commercial CANDU unit, was commissioned on Pickering A unit 1, which was declared in-service in 1971. The control functions, man-machine interface, and fault tolerant features of the dual computer control systems for the current CANDU units are described. The development of a distributed control system concept for future CANDU plants incorporating microprocessor implementation of logic functions, remote multiplexing, and redundant data highways, is also described.

11269 (EPRI-NP—4769-SR, pp 2.117-2.140) **Operating experience in using computering plant automatic start-up control system.** Kawakani, S.; Nakai, H.; Makino, M.; Mori, N.; Hirata, K.; Tsundoda, R. (Toshiba Corp., Japan). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A description of an automatic plant start-up system incorporating a process computer is presented. This system, based on and expanded automation techniques proven in fossil-fired power plants, is the world's first commercial base system for LWRs. The system automatically performs turbine start-up and controls reactor power by regulating reactor recirculation flow, thus reducing the operator's workload and improving reliability, efficiency, and accuracy of plant operation. This system is in use at Unit No. 1 of Onagawa Nuclear Power Station (a 524-MWe BWR) of Tohoku Electric Power Company, and practical operation have demonstrated the satisfactory performance of this system. Here, system configuration, major functions, reliability and safety considerations, and test and operation experience are mainly discussed.

11270 (EPRI-NP—4769-SR, pp 2.143-2.177) **Application of digital control in Japanese PWR Plants.** Taguchi, S.; Kondo, Y.; Teranishi, S.; Matsumiya, M.; Takashima, M.; Nagai, T. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

More reliable and flexible control system to improve the plant availability and operability is constantly demanded. In order to answer the demands, digital control systems are being applied to Japanese PWR plants. Microprocessor-based digital control systems are widely used in other industries and show good performance. The digital control system has been already applied to the chemical and volume control system and the radioactive waste disposal system in the operating plants. These systems have been working as expected and demonstrating good performances. The digital control system for the reactor control system, which is the main control system of the PWR plants, is being developed. The design of the system has been already finished and the verification/validation process is now in progress.

11271 (EPRI-NP—4769-SR, pp 2.181-2.201) **Digital control in Finnish power industry applications and some research and development activities.** Haapanen, P.; Winter, M. (Technical Research Center of Finland, Espoo). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

First applications of digital control systems in Finnish power plants stem from a few years time. There are at present in operation two conventional peat fuelled district heating power plants and two others are under construction. In existing nuclear power plants digital control systems are not used. Feasibility studies of a new fifth nuclear power plant have been carried out and also preliminary design exercises on its control systems has been done. It seems that the use of a digital control system in this plant is an alternative worthy of consideration. The existing digital control applications and future plans for their use in the Finnish power industry are described. The rest of the paper is devoted to the reliability questions. Software reliability is a new problem area emanating from the use of programmable digital systems. A description of a cooperative project on these questions between VTT and OECD Halden Project is given. VTT has also developed an interactive computer program, RELVEC, for plant and control system reliability analysis. The structure and use of this system is described.

11272 (EPRI-NP—4769-SR, pp 2.205-2.229) **Reliability of BWR plant digital control.** Kawakami, S.; Makino, M.; Okutani, T.; Hirayama, K. (Toshiba Corp., Japan). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Recently, many power generation plants have the digital equipment applied to the plant control and instrumentation system. The microprocessor - based equipment give a great advantage to the plant control systems with its high reliability and flexibility. The digital feedwater control system (D-FWC) in which the design is based upon the plant total control and instrumentation system is described. The D-FWC has been certified by a series of tests. These tests proved that D-FWC: is not affected by any single failure, provides an adequate margin between reactor water level and the trip point; and is to be linked to other systems without adding a number of cables, using multiplexing over fiber optics. In addition, D-FWC also has the general advantage of digital equipment that is enhanced maintainability, reduced installation space, flexibility, etc. Because of these advantages compared with conventional analog equipment, D-FWC is applicable not only for the new plants but also for the retrofit in existing plants. The technology of the plants total digital control and instrumentation system has been established.

11273 (EPRI-NP—4769-SR, pp 3.3-3.20) **Microprocessor system for low power feedwater control.** Singh, G.; French, C.T.; Simoni, L.P. (Combustion Engineer Inc., Windsor, CT). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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The results of an ongoing Combustion Engineering development program to improve steam generator level control during low power operation are presented. A discussion is presented on the analytical tools, the verification process and the simulation capabilities that are currently available for the design and evaluation of advanced steam generator control systems. A review is then presented on the dynamic processes internal to the steam generator that must be controlled, the conceptual approach used in arriving at a design, followed by the verification of the design using a detailed digital simulation of the process and the control system. Finally, a discussion is presented on the reasons for the selection of a microprocessor based systems over a conventional analog system and the potential improvements in reliability and flexibility.

11274 (EPRI-NP—4769-SR, pp 3.23-3.34) **Design concept and strategy for control systems replacement in power plants.** Nauful, E.S.; Doyel, C.B. (Babcock & Wilcox, Renfrew, England). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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Most industries must confront the eventual replacement of obsolete equipment that is difficult to maintain because of frequent failures caused by wear and the unavailability of spare parts. The replacement decision for power plants must consider the length of time required to remove the old system and replace its with new hardware so that planned outages are not exceeded. In situations where the poor performance of old equipment is merely a nuisance, the assessment of better system performance, ease of maintenance, improved reliability, and economic benefit are difficult to quantify. An instrumentation & controls (I & C) upgrade design is presented that uses current, readily available equipment that consolidates existing systems into a smaller space. The concept does not require major changes to the plant and can be accomplished during several planned outages. Other benefits gained as a byproduct of the system consolidation and upgrade are also discussed. Since 1E systems present different, more complex set of problems, only non-1E system upgrades are discussed.

11275 (EPRI-NP—4769-SR, pp 3.37-3.54) **Digital instrumentation for retrofit applications.** Dennis, U.E. (General Electric Co., San Jose, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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There can be many reasons for applying retrofit designs to existing power plants. Whatever the reasons, care in planning and instrument design will be required in order to derive the full benefits afforded by today's technology. Specifically, the availability of microprocessors and their related integrated circuits make possible capabilities, accuracies, reliabilities, maintainability and user interfaces not achievable when original equipment was designed. Some of the motives for the replacement of current instrumentation are examined and the various benefits and pitfalls of applying present day microprocessor technology to new designs are discussed. From this, a set of design objectives can be formulated that can best take advantage of modern technology. General Electric's design solution, a family of instruments called NUMAC (Nuclear Measurement, Analysis and Control) is described, followed by descriptions of instruments currently in production and those contemplated for design in the near future.

11276 (EPRI-NP—4769-SR, pp 3.57-3.70) **Fault tolerant digital control systems for boiling water reactors.** Chakraborty, S.; Cash, N.R. (General Electric Co., San Jose, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

In a Boiling Water Reactor nuclear power plant, the power generation control function is divided into several systems, each system controlling only a part of the total plant. Presently, each system is controlled by conventional analog or digital logic circuits with little interaction for coordinated control. The advent of microprocessors has allowed the development of distributed fault-tolerant digital controls. The objective is to replace these conventional controls with fault-tolerant digital controls connected together with digital communication links to form a fully integrated nuclear power plant control system.

11277 (EPRI-NP—4769-SR, pp 3.73-3.93) **Diagnostic software and fault tolerant microprocessor based system architectures.** Crew, A.W.; Wilbur, S.A.; Neuner, J.A.; Markus, D.R.; Smith, J.R.; Waclo, J.B.; Blau, P. (Westinghouse Electric Corp., Pittsburgh, PA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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In numerous industrial applications including power generation, the availability of electronic systems to perform the tasks assigned has become a major issue. At the same time, the functional complexity of these systems has increased enormously. Fortunately, the arrival of cost effective microprocessor based hardware has given the system designer a cadre of techniques to ensure the desired degree of system integrity and availability. These include: dynamic redundancy, isolation, functional diversity, built-in self-tests, embedded test subsystems, communications, error checking and error correcting codes, etc. The choice among the available techniques is generally heuristic and depends greatly on the structure of

major components and systems external to the electronic system itself as well as the postulated faults and their relative frequency. Indiscriminate use of these techniques will inevitably increase cost and reduce maintainability while actually reducing system availability and reliability. The issues and the application of these techniques are discussed by describing recent examples of fault tolerant microprocessor based system architectures which include the Plant Safety Monitoring System, the EAGLE-21 Process Protection System and the Advanced Rod Position Indication System for pressurized water reactors. Each of these systems utilize unique internal architectures that address the reliability, availability, and the communications issues while improving maintainability and man-machine interfaces.

11278 (EPRI-NP—4769-SR, pp 3.97-3.108) **Advanced control concepts for fossil central stations with applications to nuclear power plants.** Keiper, J.T.; Schider, A. (The Foxboro Co., MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

As control system design and implementation in the fossil central station generating industry tend to lag developments in the process control industry, so the nuclear power generating station control technologies follow the fossil industry. Present day fossil applications as well as industrial process control systems as precursors to future nuclear control systems are reviewed.

11279 (EPRI-NP—4769-SR, pp 4.3-4.18) **Experience with the core protection calculator system at Arkansas Nuclear One - Unit 2.** Cogburn, T.H. (Arkansas Power & Light, Russellville). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The first digital reactor reactor protection system installed in a US commercial nuclear power plant has now been operating for 5 years. This system, called the Core Protection Calculator System (CPCS) at Arkansas Nuclear One - Unit 2 (ANO-2) provides automatic reactor shutdown for protection of fuel cladding (departure from nucleate boiling) and protection against fuel center line melting (linear heat rate) for design basis events and anticipated operational occurrences. There are now three other such systems in operation: at Southern California Edison's San-Onofre Units 2 & 3 and at Louisiana Power & Light's Waterford Unit 3. The three nuclear units at Arizona Public Service's Palo-Verde station also employ a functionally identical design utilizing different hardware. The major difficulties encountered in licensing this system with The Nuclear Regulatory Commission are discussed and Arkansas Power & Light Company's experience associated with the installation, operation, modification and maintenance of the CPCS at ANO-2 is highlighted.

11280 (EPRI-NP—4769-SR, pp 4.21-4.29) **Low cost highly available digital control computer.** Silvers, M.W. (Fail-Safe Technology Corp., Los Angeles, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

When designing digital controllers for critical plant control it is important to provide several features. Among these are reliability, availability, maintainability, environmental protection, and low cost. An examination of several applications has lead to a design that can be produced for approximately $20,000 (1000 control points). This design is compatible with modern concepts in distributed and hierarchical control. The canonical controller element is a dual-redundant self-checking computer that communicates with a cross-strapped, electrically isolated input/output system. The input/output subsystem comprises multiple intelligent input/output cards. These cards accept commands from the primary processor which are validated, executed, and acknowledged. Each card may be hot replaced to facilitate sparing. The implementation of the dual-redundant computer architecture is discussed. Called the FS-86, this computer can be used for a variety of applications. It has most recently found application in the upgrade of San Francisco's Bay Area Rapid Transit (BART) train control currently in progress and has been proposed for feedwater control in a boiling water reactor.

11281 (EPRI-NP—4769-SR, pp 4.33-4.59) **Honeywell experience in distributed control system design and implementation in fossil and nuclear plants.** Richerson, J.; Spadafore, J.; Divakaruni, S.M. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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The process control industry has experienced a major transition in control systems technology based on microprocessor digital control. The microprocessor technology coupled with similar advancements in communications, software compilers, advanced software design tools, and advanced control theory has resulted in a wide range system architectures and functional distributions available. This transition has resulted in requiring new methods of developing, designing and implementing control systems. Also, these methods have provided a marked improvement in reliability and stability of the new control systems. Honeywell's ten years of experience in microprocessor based control is discussed and this experience in microprocessor based control to the nuclear industry effort is related. The recent TDC 3000 development, the design considerations, and implementation experience are described. Based on this experience, a summary of key design criteria for specification and evaluation of distributed digital control systems is discussed.

11282 (EPRI-NP—4769-SR, pp 4.63-4.73) **Application of microprocessor based controllers in the Breeder Reactor Program.** Messick, N.C.; Lucas, M.P. (Argonne National Lab., Idaho Falls, ID). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—). Contract W-31-109-ENG-38.

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The Argonne National Laboratory's experience with microprocessor-based controllers on several control loops within the EBR-II facility as well as tests being performed by these controllers is discussed. Also included is a discussion of the expandability, modularity, range of capabilities, and higher level functions possible using such equipment.

11283 (EPRI-NP—4769-SR, pp 4.77-4.92) **Fault tolerant computer for nuclear power plant applications.** Lala, J.H. (Charles Stark Draper Lab., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A quadruply redundant synchronous fault tolerant processor (FTP) is now under fabrication at the C.S. Draper Laboratory to be used initially as a trip monitor for the Experimental Breeder Reactor EBR-II operated by the Argonne National Laboratory in Idaho Falls, Idaho. The hardware architecture of this processor is described and certain issues unique to quadruply redundant computers are discussed.

11284 (EPRI-NP—4769-SR, pp 5.3-5.24) **BWR feedwater control system replacement in Monticello Plant.** Divakaruni, M.; Hammer, M.; Penland, J.; Carmichael, L.; Pierce, B. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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The largest amount of plant outage due to a single control loop malfunctioning can be attributed to the feedwater control system in the BWR. Recognizing this, EPRI initiated a digital controller conceptual design study in 1983 to evaluate options available for replacement of the current BWR analog feedwater control systems. Northern States Power's (NSP) Monticello plant was used as a reference design for this conceptual design study. The objectives of the conceptual design study are discussed. The conceptual design study was completed in February 1984 and a follow-on phase for a

detailed digital feedwater controller prototype design and development was initiated. The objectives of this detailed design phase are presented. The description and the functions of the feedwater control systems are discussed. Further, The results of the conceptual design and the status of the detailed design are provided, together with the planned activities towards implementation of the digital controller.

11285 (EPRI-NP—4769-SR, pp 5.27-5.43) **PWR feedwater system failure data as a basis for design improvements.** Mueller, N.P.; Siler, F.M. (Westinghouse Electric Corp., Pittsburgh, PA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The US nuclear power industry has a less than enviable operating availability record. The steam generator feedwater system and its control are major contributors to this unavailability record. Current failure data bring into sharp focus the major problem areas in the feedwater system. A joint program sponsored by EPRI, Tennessee Valley Authority, and Westinghouse will produce an advanced feedwater control system which is based on state-of-the-art hardware and control techniques that will substantially improve the availability of operating plants. This feedwater control system is described.

11286 (EPRI-NP—4769-SR, pp 5.47-5.73) **Optimal control strategy in the design of a PWR feedwater controller.** Gaydos, K.A.; Paris, R.E.; Gantchev, P.D.S. (Westinghouse Electric, Pittsburgh, PA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A design approach and available preliminary results are presented of work currently in progress to develop a modern alternative to the classical (present day) three-element analog steam generator water level control system for pressurized water reactors. The new control scheme is a digital feedwater controller design based on concepts of modern control theory. A basic approach is outlined which can be readily understood by industry engineers briefly acquainted with the modern control theory. A nonlinear dynamic steam generator model is developed to reasonably simulate the transient behavior of steam generator water level during typical control system transients. Deterministic optimal linear regulator theory is used to develop a multivariable feedwater controller for the steam generator and feedwater system linearized about several operating points. This controller design is now directly applicable for high power control of dry and saturated feedring-type steam generators only. Transient control performance of the feedback portion of the optimal controller is tested in computer simulation with a high-order nonlinear full plant model. Preliminary results show that the design has potential for better control performance than that of the present day control system.

11287 (EPRI-NP—4769-SR, pp 5.77-5.81) **Signal validation and failure correction algorithms for PWR steam generator feedwater control.** Nasrallah, C.N.; Graham, K.F. (Westinghouse Electric Corp., Pittsburgh, PA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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A critical contributor to the reliability of a nuclear power plant is the reliability of the control systems which maintain plant operating parameters within desired limits. The most difficult system to control in a PWR nuclear power plant and the one which causes the most reactor trips is the control of the feedwater flow to the steam generators. The level in the steam generator must be held within relatively narrow limits, with reactor trips set for both too high and too low a level. The steam generator level is inherently unstable in that it is an open integrator of feedwater flow steam flow mismatch. The steam generator feedwater control system relies on sensed variables in order to generate the appropriate feedwater valve control signal. In current systems, each of these sensed variables comes from a single sensor which may be a separate control sensor or one of the redundant protection sensors that is manually selected by the operator. In case this single signal is false, either due to sensor malfunction or due to a test signal being substituted during periodic test and maintenance, the control system will generate a wrong control signal to the feedwater control valve. This will initiate a steam generator level upset. The solution to this problem is for the control system to sense a given variable with more than one redundant sensor. Normally there are three or four sensors for each variable monitored by the reactor protection system. The techniques discussed allow the control system to compare these redundant sensor signals and generate a validated signal for each measured variable that is insensitive to false signals.

11288 (EPRI-NP—4769-SR, pp 5.85-5.90) **EPRI digital feedwater control project: system verification plans in an operating plant.** Graham, K.F.; Divakaruni, S.M. (Westinghouse Electric Corp., Pittsburgh, PA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A contract to design, build, and test an advanced digital feedwater control system for PWR steam generators is discussed. An important phase of this project is to verify the performance and operation of the system at an operating PWR. The steam generator water level control is a critical function; therefore, the prototype feedwater controller will be thoroughly tested prior to installation at the plant. Although this is a control system and not required to meet Class 1E safety system requirements, the economic consequences of upsets and reactor trips potentially caused by malfunction of this system require that the system have very high reliability. This reliability will be obtained by extensive verification and validation of the system during development, with a strong emphasis on testing.

11289 (EPRI-NP—4769-SR, pp 6.3-6.6) **Remote emergency data acquisition and control in a nuclear reactor facility.** Wensley, J.H. (August Systems, Inc., Tigard, OR). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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All industrial and commercial facilities can be subject to the need for emergency evacuation. This could be caused by an internal event such as fire, flood or explosion, or by an external event such as fire in an adjacent plant, a plane crash, or terrorist action. In many plants, there is a need to continue control even after evacuation. In others, there is the need to carry out a safety shutdown. In nuclear plants, this need is extreme and, therefore, the system that carries out the continued control or shutdown should be extremely reliable, even if the system itself has suffered damage during the event that caused the evacuation. It is, therefore, necessary to employ a fault tolerant system that is augmented to be damage tolerant. A description is presented of such a system that is distributed over five sites and which must provide reliable remote operation of four nuclear reactors.

11290 (EPRI-NP—4769-SR, pp 6.9-6.19) **Improved feedwater control through microprocessor based reactor feedpump turbine electro-hydraulic controls.** Kendall, S.W. (Westinghouse Electric Corp., Orlando, FL). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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Matched response between the feedwater control system and the reactor feedpump turbine (RFPT) control system enhances plant performance and cushions the interface between the turbine generator and feedwater systems. Digital control techniques, applied through the latest microprocessor technology, provide the flexibility to match characteristics of these systems. Most older systems use mechanical hydraulic governors utilizing a hydraulic supply common with the bearing lubrication system. Along with inherently slow dynamic responses, these systems are subject to contamination related control problems and associated high levels of maintenance. A retrofittable system is described that combines a

conversion to a high pressure electro-hydraulic fluid system with microprocessor based control technology for improved feedwater system performance.

11291 (EPRI-NP—4769-SR, pp 6.23-6.39) **Real time operating system for a nuclear power plant computer.** Alger, L.S.; Lala, J.H. (Charles Stark Draper Lab., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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A quadruply redundant synchronous fault tolerant processor (FTP) is now under fabrication at the C.S. Draper Laboratory to be used initially as a trip monitor for the Experimental Breeder Reactor EBR-II operated by the Argonne National Laboratory in Idaho Falls, Idaho. The real time operating system for this processor is described.

11292 (EPRI-NP—4769-SR, pp 6.43-6.54) **Multivariate digital control of an electric power generating plant.** Usoro, P.B.; Mehra, R.K. (Scientific Systems, Inc., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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The application of Model Algorithmic Control (MAC) to Boiler-Turbine-Generator (BTG) systems is presented. MAC is a modern control technique which is designed to mimic the action of the human operators while using the computation and data handling capabilities of digital processors. It is basically an on-line optimization controller which uses a stored input-output model of the plant and operator-chosen desired response characteristics to determine the control inputs. The technique offers promise in those areas where the lack of accurate analytical process models has prevented the use of modern control. It is shown that MAC can effectively automate and optimize the operation of power generating plants.

11293 (EPRI-NP—4769-SR, pp 6.57-6.75) **Ultra-reliable computer systems - an integrated approach for application in reactor safety systems.** Chisholm, G.H. (Idaho National Engineering Lab., Idaho Falls). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—). Contract W-31-109-ENG-38.

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Improvements in operation and maintenance of nuclear reactors can be realized with the application of computers in the reactor control systems. A reactor control system encompasses the control aspects of the reactor safety system (RSS). Equipment qualification for application in reactor safety systems requires a rigorous demonstration of reliability. For the purpose of this study, the reliability demonstration will be divided into two categories. These categories are demonstrations of compliance with respect to (a) environmental and (b) functional design constraints. An approach for the determination of computer-based RSS respective to functional design constraints only is presented. It is postulated that the design for compliance with environmental design constraints is a reasonably definitive problem and within the realm of available technology. The demonstration of compliance with design constraints respective to functionality is an extension of available technology and requires development.

11294 (EPRI-NP—4769-SR, pp 6.79-6.98) **Systematic approach to the design of a nuclear power plant hierarchical distributed digital control and protection system.** Alley, A.D.; Daniel, W.R. (General Electric, Sunnyvale, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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For some years, there has been an emphasis on power plant design in the order of the disciplines of civil, mechanical and electrical engineering. This tended also to be the approximate order of plant construction. The last decade has witnessed a growth in the plant controls and instrumentation discipline. Units have become bigger and bigger; the capital investment immense. The responsibility for monitoring the plant, protecting the investment and, in the case of nuclear plants, protecting the general public from radiation, has become a heavy burden for any nuclear plant operator to bear. A unique approach that General Electric's Nuclear Systems Technology Operation is taking to the design of plant wide control and protection systems for the Liquid Metal Fast Breeder Plant and other advanced multi-module reactor plant designs is described. This approach emphasis definition of the plant control (level of automation) and man-machine interfaces early in the design. The design of the plant controls utilizes four distinct phases: systems engineering, simulation, control systems design, and control room development and testing. These phases are discussed.

11295 (EPRI-NP—4769-SR, pp 7.3-7.14) **CUTLASS DDC language.** Clinch, D.A.L. (CEGB-Station Design Dept., Barnwood, England). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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CUTLASS is the CEBG's standard real-time software system for power station applications. It is arranged as four distinct, user orientated languages, any combination of which can be used for a particular application: a DDC language, a Sequence language, a VDU language, and a General Purpose language. All of these languages are supported by a set of Common Language Components. These provide all the standard high-level software facilities - arithmetic and logical manipulation, If statements, For Loops, Sub-Routines, etc.; also in the CLC are high-level statements through which CUTLASS code communicates with proprietary Input/Output hardware. The Common Language Components do not constitute a separate, usable language, so the General Purpose language is often used as a medium for utilizing the facilities provided by the CLC. The DDC language is discussed.

11296 (EPRI-NP—4769-SR, pp 7.17-7.40) **MATRIX/sub x/: control design and model building CAE capability for utility systems.** Gupta, N.K.; Walker, R.A. (Integrated Systems Inc., Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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Automatic control of powerplants, transmission systems, and electric networks has been used as long as such systems have existed. In general terms, the problem of plant control is one of manipulating a set of inputs such that sufficient power will be generated and transmitted to meet demand, while many plant parameters remain within specified limits. Earlier, the emphasis of automatic control had been safe operation of power plants and good regulation of desired parameters. More emphasis is now being placed on economic operation, robustness and an extremely high fault tolerance. A good example is the operation of a Boiling Water Reactor (BWR). ISI has developed a computer-aided-engineering (CAE) system MATRIX/sub x/ for the design, analysis and verification of multivariable as well as nonlinear control systems. MATRIX/sub x/ and an associated capability System Build are unique in that they provide modeling, simulation, optimization and control design facilities in an integrated environment with a common data base. MATRIX/sub x/ is the leading CAE control system design package. The capabilities of Version 4.0 of MATRIX/sub x/ and SYSTEM BUILD are discussed and an approach to integrate Modular Modeling System (MMS) features into MATRIX/sub x/ is proposed.

11297 (EPRI-NP—4769-SR, pp 7.43-7.67) **Application of MVPACK to the design of multivariable control systems for a nuclear steam generator.** Hinds, H.W. (Atomic Energy of Canada, Chalk River, Ontario). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

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Control systems for most nuclear power plants are designed using conventional single-variable methods which treat each control loop independently. Interactions between loops are accounted for empirically by tuning the controllers to achieve the desired results. As plants increase in size and complexity, and are required to operate closer to maximum capability for greatest economic returns, these dynamic interactions become more important and render the extrapolation of these techniques unreliable. MVPACK is a user-friendly software package that combines a powerful capability to design and analyze complex multivariable control systems, both in state space and transfer function form, with an ease of application. MVPACK is a set of interactive modules that appears to the user as a high-level calculator. It is composed of a database, interaction methods, a mathematical library, and an extensive collection of design algorithms including: order reduction of linear models; pole shifting with output feedback; modal control; optimal control with stochastic state estimation; and the inverse Nyquist array method. The design of multivariable controllers for a nuclear steam generator is discussed. The available outputs of the 15th-order model are steam pressure and water level; control inputs are steam and feedwater flows. Four of the design techniques implemented in the MVPACK module are outlined and then applied to this model.

11298 (EPRI-NP—4769-SR, pp 7.71-7.95) **Software summaries.** Fredericks, D.K.; Herget, C.J.; McFarland, F. (Rensselaer Polytechnic Institute, Troy, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A listing containing 37 brief summaries of computer-aided control system design software packages, as compiled by Professor Dean K. Frederick of Rensselaer Polytechnic Institute and Dr. Charles J Herget and Fan McFarland of Lawrence Livermore National Laboratory is presented. Updated versions of these summaries will be made available in the future.

11299 (EPRI-NP—4769-SR, pp 7.99-7.119) **Control-C and ACSL for computer-aided control systems engineering.** Schrick, B.; Anex, R. (Systems Control Technology, Inc., Palo Alto, CA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A computer-aided engineering package, called CTRL-C, provides an easy-to-use work-bench for the analysis and design of multivariable systems. ACSL, a powerful simulation language, complements CTRL-C and provides a flexible evaluation tool. Combined, the CTRL-C/ACSL package is an interaction environment with a comprehensive set of tools for analysis, design, simulation, and evaluation. A unified software system is possible for engineering analysis and presentation. Recognizing that no software can satisfy all needs, Ctrl-C provides consistent and flexible communication with the operating system and other software, most especially ACSL. CTRL-C and ACSL demonstrate that an interactive environment can be a powerful, accessible, and extensible tool for engineering.

11300 (EPRI-NP—4769-SR, pp 8.3-8.7) **Systematic nonlinear controller design approach based on quasilinear system models.** Taylor, J.H. (General Electric Corporate Research and Development, Schenectady, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Recent research in the area of describing function approaches (both random-input and sinusoidal-input) has laid the foundation for a systematic approach to designing controllers for nonlinear plants. An overview of one school of though in this area is presented, typified by the following key ideas: (1) quasilinear models of the nonlinear system that account for the operating range of system variables must be more realistic than conventional linear models; (2) a staged design approach that applies more power to difficult nonlinear plants than to easy ones is more sensible than a single design method, and (3) the designer should be led to a nonlinear controller design if and only if it is really required. These points are developed, illustrated and justified.

11301 (EPRI-NP—4769-SR, pp 8.11-8.18) **Applications of nonlinear controller design approach based on quasilinear system models.** Taylor, J.H.; Strobel, K.L. (General Electric Corporate Research and Development, Schenectady, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Recent progress in developing nonlinear control system design techniques based on sinusoidal-input describing function (SIDF) method is reported. Primarily, this involves illustrating a fundamental difference between SIDF and random-input describing function (RIDF) models of nonlinear systems, developing the nonlinear controller design method more fully, and demonstrating it by applying it to a significant nonlinear control design problem in robotics. Based on these results, the use of this nonlinear controller design method should be substantially better understood.

11302 (EPRI-NP—4769-SR, pp 8.21-8.25) **Nonlinear control system design based on quasalinear system models.** Taylor, J.H.; Strobel, K.L. (General Electric Corporate Research and Development, Schenectady, NY). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Recent progress in developing nonlinear control system design techniques based on sinusoidal-input describing function (SIDF) methods is reported. This work includes the development of a new nonlinear compensator synthesis approach, and its application to a single-axis servo design problem of the sort encountered in robotics. This approach is capable of treating nonlinear systems of a very general nature, with no restrictions as to system order, number of nonlinearities, configuration, or nonlinearity type. The end result is a closed-loop nonlinear control system that is relatively insensitive to reference input amplitude.

11303 (EPRI-NP—4769-SR, pp 8.29-8.37) **Recent advances in linear multivariable control design.** Vidyasagar, M. (Univ. of Waterloo, Ontario). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Some recent advances in linear multivariable control design, which are based on the so-called Stable Factorization (SF) approach are reviewed. This approach combines the computational facility of state-space based methods with the insensitivity of frequency domain methods. At the same time, it allows the designer to incorporate, as a part of the design process, various important practical considerations such as limitations on the plant input amplitude, robustness against modeling errors and parameter uncertainty, preservation of system behavior in the presence of contigencies, design of linear controllers for nonlinear systems, etc. The approach itself is very new and is still evolving. As a result, all of the literature on the topic is directed towards the research community and none towards the practitioner.

11304 **(EPRI-NP—4874-Vol.2) Graphic display development methodology: Volume 2, Appendixes: Final report.** Pankrantz, D. (Operations Engineering, Inc., Fremont, CA (USA)). Nov 1986. 175p. NTIS, PC A08/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87003330.

The Graphic Display Development Program is intended to develop computer-based displays which support the symptomatic emergency operating procedures for BWRs. The purpose is to provide a technical basis and methodology for linking two post-TMI safety initiatives: improved operating procedures and the Safety Parameter Display System. Whereas consistency between displays and emergency operating procedures is desirable, no assumption of such an NRC requirement is either expressed or implied in this docu-

ment. Accordingly, this program should be viewed not as the only acceptable approach to SPDS design but as one of many possible approaches which may be pursued. This program has been supported as a generic activity on behalf of the Boiling Water Reactor Owner's Group (BWROG). No endorsement by any individual utility member of the BWROG is either expressed or implied in this document nor is any utility obligated to implement this program at any plant.

11305 (IHZ-WIK—85-533/601/2, pp 50-51) **Diagnostics of primary coolant circuit equipment in nuclear power plants with WWER-440 type reactors in the CSSR.** Jaros, I.; Bahna, J. (Forschungsinstitut fuer Kernkraftwerke, Jaslovske Bohunice, Czechoslovakia). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780051. (CONF-8504237—Pt.2).

From 7. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (16 Apr 1985).

A method of diagnostics of primary coolant circuit components is presented for nuclear power plants with WWER-440 type reactors in the CSSR. The following surveillance methods are used: (1) vibration monitoring, (2) detection of loose parts in the primary circuit, (3) leak monitoring of the coolant in the primary circuit, (4) registration of thermal crack formation and propagation, and (5) monitoring of the acoustic field. The different subsystems are controlled by a process computer. Recording, processing and analyzing of the diagnostic signals and the storage of the results are carried out by means of digital computer techniques which are briefly illustrated. In order to increase the efficiency of the diagnostic methods a Central Laboratory for Diagnostics attached to the Ministery of Coal and Energy of the CSSR is being established.

11306 (IHZ-WIK—85-533/601/2, pp 51-54) **Trends of information processing by means of process computers for reactor operators in the Federal Republic of Germany.** Buettner, W.E. (Gesellschaft fuer Reaktorsicherheit m.b.H., GRS, Garching, Germany, F.R.). 1985. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780051. (CONF-8504237—Pt.2).

From 7. scientific conference on power industry of the Ingenieurhochschule Zittau; Zittau, German D.R. (16 Apr 1985).

Trends in design of process computer-aided information systems in nuclear power plants in the Federal Republic of Germany are presented. The study is restricted to systems used for the information of the operators in the control room. The following main application fields for process computer systems are described: (1) recording and documentation, (2) reduction of information load of operators during failures, (3) performance testing during normal and disturbed plant situations, (4) improvement of information representation by display devices and automatic processing, (5) failure analysis and monitoring, alarm handling, (6) display and implement of procedures from the operation manual or parts of it.

11307 (NUCLEBRAS-CDTN—534) **Auxiliary control system of the safety parameters for IPR-R1 reactor.** Coura, J.G. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700461.

This paper deals with the description for the control of three cooling water parameters (conductivity, temperature and the maximum and minimum water levels) as well as the percent power fraction of the nuclear research reactor IPR-R1. In order to keep the reactor in good operation conditions, one permanent and accurate control of the cooling water is needed. The double monitoring of a fourth parameter, part of the original design, the percent power fraction, is obtained through the control of the uncompensated ion chamber current and aims to avoid the operation of the reactor without running the cooling system.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 11413, 11414, 12267

11308 **Volatilization and reaction of fission products in flowing steam.** Johnson, I.; Steidl, D.V.; Johnson, C.E. (Argonne National Lab., Chemical Technology Div., 9700 South Cass Avenue, Argonne, IL 60439). pp 199-210 of Fission product behavior in ceramic oxide fuel. Hastings, I.J. Columbus, OH; American Ceramic Society (1986). (CONF-850536—).

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

The behavior of fission product, control rod, and structural material deposits has been studied by heating a nonradioactive mixture of CsI, CsOH, TeO/sub 2/, SrO, Ag, Sn, C, In, and Mn in a flowing steam-hydrogen gas steam. The mixture was contained in a stainless steel boat. Temperatures of 500°, 750°, and 100°C were used. Cesium, I, Te, Cd, and In were transported out of the boat. The transport of Cd was controlled by its partial pressure above the alloy. The observed transport of CsI indicated that complex gaseous species such as CsI. CsOH and CsI . xH/sub 2/O may be present and increase its volatility. Tellurium was transported as gaseous Te and controlled by the stability of tellurides formed with stainless steel or indium. The small transport of In, observed only at 1000°C, is believed due to the formation of gaseous InTe species.

11309 **Analysis of transient fission-gas release and swelling in oxide fuel.** Gruber, E.E. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL 60439). pp 249-258 of Fission product behavior in ceramic oxide fuel. Hastings, I.J. Columbus, OH; American Ceramic Society (1986). (CONF-850536—).

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

Fission-gas behavior was calculated with an updated version of the FRAS3 code for the FGR-40 series of transient tests of irradiated PNL-10 fuel. This same series of tests was used in an earlier evaluation study with a preliminary version of the code. While that study provided positive support for the modeling approach, it also indicated deficiencies in some areas. Although a number of improvements have been implemented in the current version of the code, this study examines the effect of an explicit treatment of bubble growth within the grains, including the effect of vacancy depletion caused by the competition of overpressured bubbles for available vacancies. The result is a reduction by as much as 90% in the predicted swelling, accompanied by an increase in transfer of gas from the grains to boundaries. Both swelling and gas-release predictions are brought into much better agreement with the observed values.

11310 **Combined grain-boundary and lattice diffusion in fine-grained ceramics.** Olander, D.R. (Univ. of California, Dept. of Nuclear Engineering and the Materials and Molecular Research Div., Lawrence Berkeley Lab., Berkeley, CA 94720). pp 271-294 of Fission product behavior in ceramic oxide fuel. Hastings, I.J. Columbus, OH; American Ceramic Society (1986). (CONF-850536—). Contract AC03-76SF00098.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

A mathematical model of species transport in a fine-grained polycrystalline body is developed and applied to postirradiation anneal experiments of volatile fission-product release from UO/sub 2/ and to oxygen self-diffusion in the same material. The model treats the simultaneous transport paths of (1) direct volume diffusion (the only mechanism available in single crystals) and (2) lattice diffusion from the grain interior to the grain boundaries, followed by migration in the latter. The two physical properties controlling the release process are the diffusion coefficient in the lattice and the product of the grain-boundary diffusivity and the solute segregation coefficient between the lattice and the grain boundaries. To determine these properties, either two independent-release tests with specimens of different grain size or a measurement of the concen-

tration distribution of the diffusing species in the specimen after the anneal is needed.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 10910, 11242, 11262, 11307, 11408

11311 (CONF-851268—, pp 1-11) **Neutron scattering.** Fender, B. (Univ. of Keele, Staffordshire, England). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

Thermal neutron scattering is a very important probe of the properties of condensed matter. This paper discusses the reactor sources of such neutrons for scattering and the major instruments at these sources. Neutron diffraction leads to studies on the structure of powders, magnetic materials, liquids and amorphous solids, and the shapes of polymers, micelles, colloids and biological molecules. Neutron inelastic scattering studies spin waves, excitations in incommensurate structures, diffusion processes and critical scattering. Future possibilities are even more extensive than past accomplishments.

11312 (CONF-851268—, pp 26-33) **Neutron irradiation facilities for fission and fusion reactor materials studies.** Rowcliffe, A.F. (Oak Ridge National Lab., TN). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract AC05-84OR21400.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The successful development of energy-conversion machines based upon nuclear fission or fusion reactors is critically dependent upon the behavior of the engineering materials used to construct the fuel containment and primary heat extraction systems. The development of radiation damage-resistant materials requires irradiation testing facilities that reproduce, as closely as possible, the thermal and neutronic environment expected in a power-producing reactor. The Oak Ridge National Laboratory (ORNL) reference core design for the Center for Neutron Research (CNR) reactor provides for instrumented facilities in regions of both hard and mixed neutron spectra, with substantially higher fluxes than are currently available. The benefits of these new facilities to the development of radiation damage resistant materials are discussed in terms of the major US fission and fusion reactor programs.

11313 (CONF-851268—, pp 34-40) **Nuclear physics program and experimental needs.** Wilson, R. (Harvard Univ., Cambridge, MA). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The paper reviews work on the properties of the neutron, of strong interactions of neutrons, and of weak interactions of neutrons, identifying how and where the experiments can be improved, and the needs that these suggest for a new high flux reactor.

11314 (CONF-851268—, pp 41-52) **Ultrahigh flux reactor design probing the limits of plate fuel technology.** Lake, J.A.; Parsons, D.K.; Liebenthal, J.L.; Ryskamp, J.M.; Fillmore, G.N.; Deboisblanc, D.R. (Idaho National Engineering Lab., Idaho Falls). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract AC07-76ID01570.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The need for a new steady-state thermal neutron source of unprecedented intensity has been the subject of numerous national meetings and discussion. The National Research Council Committee on Major Facilities for Materials Research recently issued a high priority recommendation that site-independent design studies for such a facility begin immediately. The high intensity neutron sources is projected to open new frontiers in the use of neutrons as a probe in various aspects of materials and biological research and fundamental physics. The challenge put forth by the research community is to produce a source with a tenfold increase in intensity over any currently operating or planned facility and, therefore, to thrust the thermal neutron flux intensity into the 10^{16} n/(cm^{2}s) range. The purpose of the recent Idaho National Engineering Laboratory (INEL) activities in this area has been to identify and examine the limitations and the capabilities of the historically well-characterized plate-fuel technology to achieve the required performance levels in a user-friendly environment. Workbench design concepts were identified, upon which constraints and performance limitations could be evaluated and parametric trade-off analyses and preliminary design optimization studies could be performed. Although considerable optimization remains to be performed and a large number of cost/benefit trade-offs exist, it appears that a reactor core with innovative geometry, constructed of plate-type fuel elements, can achieve, the 10^{16} n/(cm^{2}s) l thermal flux level in a large external volume which has the quality and accessibility for beam research.

11315 (CONF-851268—, pp 53-57) **Thermal-hydraulic constraints on water-cooled research reactor performance.** Gambill, W.R. (Oak Ridge National Lab., TN). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract AC05-84OR21400.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The primary factors involved in the thermal-hydraulic design of water-cooled research reactor cores are briefly discussed. The approach taken in the preliminary design of the reactor for the proposed Center for Neutron Research (CNR) is simultaneously described.

11316 (CONF-851268—, pp 58-65) **Preliminary reactor design for the center for neutron research.** Difilippo, F.C.; Gambill, W.R.; Moon, R.M.; Primm, R.T.; West, C.D. (Oak Ridge National Lab., TN). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract AC05-84OR21400.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The Center for Neutron Research is a new, national experimental facility being planned by Oak Ridge National Laboratory to meet the need for an intense steady-state source of neutrons and for associated experimental space and equipment. The article describes a preliminary design for a reactor to serve as the neutron source. The design offers an unprecedented thermal neutron flux for scattering experiments (5×10^{19} to 10×10^{19} neutrons m^{-2} s^{-1}) as well as capabilities for isotope production and engineering materials irradiation experiments that surpass those at present research reactors.

11317 (CONF-851268—, pp 66-76) **High flux research reactors based on particulate fuel.** Powell, J.R.; Takahashi, H.; Horn, F.L. (Brookhaven National Lab., Upton, NY). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract AC02-76CH00016.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

High flux particle bed reactor (HFPBR) designs based on high temperature gas reactors (HTGR) particulate fuel are described. The coated fuel particles, ~500 μm in diameter, are packed between porous metal frits, and directly cooled by flowing D_2O. The large heat transfer surface area in the packed bed, ~100 cm^2/cm^3, allows high power densities, typically 10 MW/l. Peak thermal fluxes in the HFPBR are 1 to 2 x 10^{16} n/(cm^{2}s), depending on configuration and moderator choice, with beryllium and D_2O moderators yielding the best flux performance. Spent fuel particles can be hydraulically unloaded every day or two and fresh fuel reloaded. The short fuel cycle allows HFPBR fuel loading to be very low, ~2 kg of ^{235}U, with a fission product inventory one-tenth of that in present high flux research reactors. The HFPBR can use partially enriched fuel, 20% ^{235}U, without degradation in flux or reactivity.

11318 (CONF-851268—, pp 77-90) **Very high-flux research reactor concepts.** Olson, A.P. (Argonne National Lab., IL). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract W-31-109-ENG-38.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

Performance capabilities of liquid-metal-cooled, hard spectrum cermet cores are compared to those of water silicide and uranium-aluminum cores, as sources for very high, steady-state neutron fluxes. A novel core concept is introduced which has potential for overcoming conventional power density limitations, resulting in extremely high flux levels in steady-state.

11319 (CONF-851268—, pp 123-124) **Additional user needs.** Rorschach, H.E.; Hayter, J.B. (Rice Univ., Houston, TX). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The paper summarizes the conclusions of a discussion group on users' needs held at the Workshop on an Advanced Steady-State Neutron Facility. The discussion was devoted to reactor characteristics, special facilities and siting considerations suggested by user needs.

11320 (CONF-851268—, pp 125-131) **Report on the working group on critique of source concepts.** Lake, J.A.; West, C.D. (EG and G Idaho Inc., Idaho Falls). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The Working Group on Critique of Source Concepts examined and evaluated the proposed reactor- and accelerator-based steady state neutron source concepts with regard to: performance and fit to user needs, technical feasibility and R and D requirements, capital and operating costs, and unique safety or siting issues. A more or less conventional, D_2O cooled and moderated research reactor, utilizing evolutionary advances in aluminum plate-fuel technology, can produce the desired 10^{16} n/cm^{2}s flux levels in a large, accessible, user-friendly environment, with a relatively modest and low-risk R and D program, and at the lowest cost.

11321 (DOE/ER/04014—16) **University of Florida Training Reactor: Annual progress, September 1, 1985-August 31, 1986.** Vernetson, W.G. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). Nov 1986. Contract AC05-76ER04014. 260p. (ORO—4014-16). NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87003316.

Information is presented concerning: University of Florida personnel associated with the reactor; Facility operation; Modifications to the operating characteristics or capabilities of the UFTR facility; Significant maintenance, tests and surveilliances of UFTR reactor systems and facilities; Changes to technical specifications, standard operating prceedures and other documents; Radioactive releases and environmental surveillance; Education, research and training utilization; and Theses, publications, reports and oral presentations of work related to the use and operation of the UFTR.

11322 (NUREG/CR—4717) **Irradiation history and final postirradiation data for IFA-432.** Lanning, D.D. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 76p. (PNL—5971). NTIS, PC A05/MF A01 - GPO. File Number TI87003403.

The irradiation history and final postirradiation examination (PIE) results are presented for the Halden fuel assembly IFA-432. In particular, the three instrumented rods (Rods 2, 3, and 5) that continued to the highest burnup (46 MWd/kgM) are emphasized. The long survival rate of the fuel instrumentation allowed a continuous record to be kept of linear heat generation rate and fuel temperatures throughout the operating history of the asembly. Fission gas release was estimated based on a combination of gas retention and ceramographic data. The PIE data show that the postirradiation condition of the rods is qualitatively consistent with the power/temperature histories experienced. Fission gas release estimates are: Rod 2 (380 μm as-fabricated gap), 20-40%; Rod 5 (230 μm as-fabricated gap), 20-40%; and Rod 3 (76 μm as-fabricated gap), 0-20%.

11323 (PPA-BEN—3, pp 41-57) **Cooperative utilization of Rikkyo University Reactor (RUR).** Susumu Harasawa. (Rikkyo Univ., Yokosuka, Kanagawa, Japan. Inst. for Atomic Energy). 1985. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780031. (CONF-8502142—).

From Workshop on scope and technical application of neutron activation analysis; Bangi, Selangor, Malaysia (5 Feb 1985).

Rikkyo University Reactor (TRIGA Mark-11, 100kW max.) became critical on 8th December 1961. This reactor still belongs to the Rikkyo University but was utilised by all universitites under the cooperative research program sponsored by the Ministry of Culture and Education of Japan, launched 1974. The projects under this program number about forty every year. Neutron activation analysis is the main research field in this program and account for more than 60 per cent of the accepted projects. Under this cooperative research program, various documents and procedures for the use of the reactor and its facilities were prepared for users to familiarize them with NAA staff of Rikkyo University. Some of these procedures are listed as follows: 1. Commentaries of neutron activation analysis; 2, Procedures of applying for this program; 3. Descriptions of irradiation facilities in the reactor; 4. Instruction of radiation monitoring in the radiation controlled area; 5. Regulations of transportation of radioactive material; 6. Preparation of irradiation capsules and cadmium covers; 7. Training for safe handling of radioactive materials. A meeting is held annually on the subject of the neutron activation analysis to discuss and interchange the useful information

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 11242, 12711

11324 (CONF-851268—, pp 13-19) **Transuranium isotopes.** Hoffman, D.C. (Lawrence Berkeley Lab., CA). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306. Contract AC03-76SF00098.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The needs of the research community fr the production of transuranium isotopes, the quantities required, the continuity of production desired, and what a new steady state neutron source would have to provide to satisfy these needs are discussed. Examples of past frontier research which need these isotopes as well as an outline of the proposed Large Einsteinium Activation Program, LEAP, which requires roughly ten times the current production of ^{254}Es, are given.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 11232, 11939, 12269, 12270, 12271, 12274, 12302, 12303, 12309, 12996

11325 (BNL-NUREG—38839) **Fire environment determination in the LaSalle NPP control room.** Usher, J.L.; Boccio, J.L.; Singhal, A.K.; Tam, L.T. (Brookhaven National Lab., Upton, NY (USA); CHAM of North America, Inc., Huntsville, AL (USA)). 1986. Contract AC02-76CH00016. 8p. (CONF-860908—35). NTIS, PC A02/MF A01 - GPO. File Number TI87002582.

From Operability of nuclear power systems in normal and adverse environments meeting; Albuquerque, NM, USA (29 Sep 1986).

One objective of NRC's Fire Protection Research Program (FPRP) is to improve the modeling of environments caused by fires in typical nuclear power plant enclosures. A three-dimensional fluid dynamics computer code (PHOENICS) has been adapted as a field-model fire code (SAFFIRE) for this purpose. The model has been

applied to simulate two distinct fires in the control room of the La-Salle County power plant. The environments determined illustrate hazardous potential for both personnel and equipment.

11326 **(BNL-NUREG—38871) Evaluation of systems/equipment important to safety: Davis Besse, a perspective example.** Karimian, S. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-860908—36). NTIS, PC A02/MF A01 - GPO. File Number TI87002583.

From Operability of nuclear power systems in normal and adverse environments meeting; Albuquerque, NM, USA (29 Sep 1986).

Presently, systems and equipment within a nuclear power plant are classified as safety or non-safety related systems and equipment. After the TMI-2 accident, it was clear that several systems and equipment important to safety were not designed, fabricated, and maintained at the level equivalent to their safety importance. The classification methodology and examples used in this paper could assist in understanding such complex issues as well as identifying such system equipment S/E.

11327 **(BNL-NUREG—38934) Operational safety reliability research.** Hall, R.E.; Boccio, J.L. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 16p. (CONF-8610135—39). NTIS, PC A02/MF A01 - GPO. File Number TI87003230.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Operating reactor events such as the TMI accident and the Salem automatic-trip failures raised the concern that during a plant's operating lifetime the reliability of systems could degrade from the design level that was considered in the licensing process. To address this concern, NRC is sponsoring the Operational Safety Reliability Research project. The objectives of this project are to identify the essential tasks of a reliability program and to evaluate the effectiveness and attributes of such a reliability program applicable to maintaining an acceptable level of safety during the operating lifetime at the plant.

11328 **(DOE/NE—0076) Report of the US Department of Energy's team analyses of the Chernobyl-4 Atomic Energy Station accident sequence.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC). Nov 1986. 188p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003614.

In an effort to better understand the Chernobyl-4 accident of April 26, 1986, the US Department of Energy (DOE) formed a team of experts from the National Laboratories including Argonne National Laboratory, Brookhaven National Laboratory, Oak Ridge National Laboratory, and Pacific Northwest Laboratory. The DOE Team provided the analytical support to the US delegation for the August meeting of the International Atomic Energy Agency (IAEA), and to subsequent international meetings. The DOE Team has analyzed the accident in detail, assessed the plausibility and completeness of the information provided by the Soviets, and performed studies relevant to understanding the accident. The results of these studies are presented in this report.

11329 **(DOE/SSDP—0012) Shippingport Station Decommissioning Project (SSDP). A progress report.** Mullee, G.R.; Usher, J.M. (General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations; USDOE Shippingport Station Decommissioning Project Office, PA). 1986. Contract AC06-76RL01857;AC06-84RL10421. 8p. (CONF-860905—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000419.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

The Shippingport Atomic Power Station was shutdown in October, 1982 by the Plant Operator, Duquesne Light Company, for decommissioning by the US Department of Energy. The planning for decommissioning was completed in September, 1983. In September, 1984 operational responsibility for the station was transferred to the DOE's Decommissioning Operations Contractor - the General Electric Company (assisted by an integrated subcontractor, MK Ferguson Company). Significant accomplishments to date include the completion of all prerequisites for decommissioning, the removal of asbestos from plant systems, loading of irradiated reactor components into the reactor vessel for shipment, the commencement of electrical deactivations and the commencement of piping/component removal. Decontamination and waste processing are progressing in support of the project schedule. The reactor vessel will be shipped as one piece on a barge for burial at Hanford, Washington. The final release of the site is scheduled for April, 1990. A technology transfer program is being utilized to disseminate information about the project.

11330 **(EGG-M—13686) Review of operating experience on Engineered Safety Features Actuating Systems.** Meyer, L.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 24 Oct 1986. Contract AC07-76ID01570. 5p. (CONF-861007—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002612.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

Operating experience with the Engineered Safety Features Actuating System (ESFAS), as reported in the Nuclear Power Experiences data base, and selected plant records, is presented. The purpose of this study is to evaluate the potential significance of aging, including cycling, trips, and testing as contributors to degradation of the ESFAS. Tables are presented that show the percentage of failure events classified by component, subcomponent, and cause for boiling water reactors and pressurized water reactors. A representative engineered safeguards actuating channel was selected for detailed study. Functional indicators of degradation and testing requirements are evaluated.

11331 **(EGG-M—13986) Aging system interaction studies: In-depth engineering studies of selected systems.** Jacobs, P.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 24 Oct 1986. Contract AC07-76ID01570. 5p. (CONF-861007—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002608.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A research program sponsored by the US Nuclear Regulatory Commission to investigate the aging impact on nuclear plant safety is described. The program progress to date is summarized and plans for FY-1987 and beyond are discussed.

11332 **(EGG-M—34586) Functionality and leak integrity of containment penetration systems subjected to design basis dynamic loads.** Steele, R. Jr.; Hill, R.C.; Close, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 19p. (CONF-8610135—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002614.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The results of testing typical US nuclear power plant containment piping penetrations during seismic excitation are presented. Full-sized hardware, including the containment wall penetration, piping, pipe supports, and the isolation valve, were subjected to seismic excitation typical of levels specified in US nuclear power plant designs. The effect of the seismic excitation on valve leakage and operability and the effect on overall system integrity were studied. All hardware performed well and showed no degradation as a result of the seismic loads.

11333 (EML—460, pp 259-264) **International data exchange and cooperative research.** Krey, P.W. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

The author reports important issues concerning the Chernobyl reactor accident discussed in the Lund Conference held in Lund, Sweden, June 7-11, 1986 and during visits to environmental research laboratories in Sweden, Denmark and England. Their discussions centered on the need to: accumulate a large data base of information; interpret trends in nuclide behavior; provide additional data to explore or verify such trends, and communicate information

among researchers on the work in progress and future plans so that a complete description of the accident and its effects can be constructed.

11334 (EPRI-NP—4750-SR, pp 1.3-1.9) **Overview of EPRI safety control projects.** Sun, B.K.H. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The need to reduce plant risk, coupled with the utility effort of upgrading their computer capability to meet government regulatory requirements for Emergency Response Facilities, generate an impetus for the application of computer-aided technology to nuclear plant operations. The objective of the Safety Control Systems research is to develop computerized hardware and software systems for the utilities as technical options to reducing safety challenges, increasing operating margins, and enhancing plant productivity while minimizing the effects of plant aging and retrofit. The general technical approach of safety control is to utilize the recent advances of computer hardware and software technology to the specific needs of the nuclear power plants. These approaches are described by three technological feedback paths focusing on the plant: digital control systems, computerized information systems and computerized analytical engineering and tools. Goals for in these areas and coordination with utilities are described.

11335 (EPRI-NP—4750-SR, pp 1.13-1.22) **Utility perspectives of computer technology.** Rueter, D.A. (Arkansas Power and Light Co., Little Rock). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The authors review experience at the Arkansas Nuclear One facility with computer systems and provides comments on the effectiveness of recent computer applications. The use of digital computer technology in protection and control systems is discussed and the experience is translated into recommendations for future work by the Electric Power Research Institute.

11336 (EPRI-NP—4750-SR, pp 1.25-1.31) **Benefits of the computerized operator aid systems.** McMeeken, T.C. (Duke Power Co., Charlotte, NC). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Duke Power company continues to seek out technological advances which could potentially enhance safe, reliable, efficient power generation, transmission and distribution. The application of process computer systems is a good example of advancing technology at work, assisting power companies in fulfilling their objective. It is the focus of this paper to give an overview of the range of applications applied at Duke Power Company and to highlight their associated benefits.

11337 (EPRI-NP—4750-SR, pp 1.35-1.41) **Post TMI-2 emphasis on digital systems applications.** Broughton, T.G. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The overall role of digital systems application in US nuclear power plants has expanded since the TMI-2 accident. The changes have been most evident in the role of the process computer in providing information to the control room operating crew including use of SPDS during off-normal conditions. This has been accomplished by an expanded role during normal operations which includes addition real-time performance monitoring, administrative support, and integration of displays with procedures. The challenges of effectively applying the technology include understanding information requirements for off-normal events and developing methodologies to prevent information overload during off-normal events.

11338 (EPRI-NP—4750-SR, pp 1.45-1.60) **Role of high technology in the nuclear industry.** Cain, D.G. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

A discussion of high technology identifies the characteristics which distinguish it from conventional technologies, and the impact high technology will have in the nuclear power industry in the near future. The basic theme is that high technology is an ensemble of competing technological developments that shifts with time and technological innovation. The attributes which current distinguish high technology are compactness, plasticity, convergence, and intelligence. These high technology attributes are presented as a prelude to some examples of high technology developments which are just beginning to penetrate the nuclear industry. Concluding remarks address some of the challenges which must be faced in order to assure that high technology is successfully adapted and used.

11339 (EPRI-NP—4750-SR, pp 2.3-2.16) **Industry practices for signal validation and EPRI projects.** Divakaruni, S.M. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

With the current thrust to introduce digital computers to support plant monitoring and operator aid functions such as the Safety Parameter Display System (SPDS), signal validation has become generally recognized as a key element in the interface between plant sensors and algorithms using sensor data, and is a prerequisite to be successful. For a system such as the SPDS to be robust and to yield a false alarm rate that is credibly low, high information reliability must be assured at the front end. A single data base, validated with the methodology being developed and demonstrated in EPRI projects, is an effective and efficient means for achieving reliable and consistent information for use by the nuclear plant operations staff. In addition, the system will also be albe to supply performance information about instrumentation and components which will greatly simplify routine testing and maintenance scheduling.

11340 (EPRI-NP—4750-SR, pp 2.19-2.31) **Description and parity space and analytic redundancy techniques.** Deutsch, O.L. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Signal validation is a method of using information from the entire suite of plant instrumentation in an integrated and systematic manner. Through several research projects and actual implementations at the MIT Reactor and EBR-II plant, and under sponsorship of the Electric Power Research Institute, the Department of Energy, and internal funds, the Draper laboratory has developed generic software and a methodology for applying signal validation in power plant instrumentation and control. In collaboration with the Babcock and Wilcox Company, the author is currently designing a modular signal validation system for primary-side variables in pressurized water reactor plants under EPRI 2292-1. This paper will describe the mathematical basis and design considerations for this concept of signal validation.

11341 (EPRI-NP—4750-SR, pp 2.35-2.56) **PWR signal validation project results and implementation at Millstone-2.** Firth, D.J.; Lutz, R.I. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The Electric Power Research Institute has sponsored the Babcock and Wilcox Company in a project titled Validation and Integration of Critical PWR Signals. The project is scheduled to cover 30 months and is designed to produce software which can be directly used on a variety PWR process computer systems. While the concept of signal validation using parity space theory has been

applied in other industries for many years, this development project is only one of a handful in the nuclear industry. Although the project is just two-thirds complete, some positive results have been shown for the projects' scope. As such, this paper and supporting demonstration show that the theory of parity space techniques can be successfully applied to nuclear power plant instrumentation.

11342 (EPRI-NP—4750-SR, pp 2.59-2.66) **Northeast Utilities signal validation applications for Millstone - 3 and Connecticut Yankee plants.** Blanch, P.M.; Meyer, J.E. (Massachusetts Institute of Technology, Cambridge). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

This paper covers two very different applications of signal validation to the treatment of plant measurements. In the first application (the Millstone-3 plant, under construction), measurements that are inputs to the safety parameter display system (SPDS) are treated. In the second application (the Connecticut Yankee plant, initial commercial operation 1968), steam plant measurements needed for secondary performance monitoring are treated.

11343 (EPRI-NP—4750-SR, pp 2.69-2.74) **On-line confirmation of Zion plant variables.** Marianyi, J.; Ornedo, R. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Each electric utility participating in EPRI's SPDS Signal Validation project was requested to submit a list of the variables that were to be used in the design of the Safety Parameter Display System (SPDS). Millstone 2, a Combustion Engineering plant was selected as the host plant, i.e., the plant for which to design and install signal validation software. Zion Station was selected as the reference plant, i.e. the plant to check the Millstone design against to ensure the results were generic to most PWR's. At the onset of this project, Zion already had a functional SPDS, so it was relatively easy to compile and submit a list of variables. This was done by the participants and the variables were presented in tabular form. To everybody's surprise, a comparison between plants showed a wide variance in perception of what was required of the SPDS. Due to this diversity, it was decided to take a fresh look at the Zion SPDS and confirm that the selected variables were indeed adequate.

11344 (EPRI-NP—4750-SR, pp 2.77-2.100) **BWR level estimation using Kalman Filtering approach.** Garner, G.; Divakaruni, S.M.; Meyer, J.E. (Charles Stark Draper Lab. Inc., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Work is in progress on development of a system for Boiling Water Reactor (BWR) vessel level validation and failure detection. The levels validated include the liquid level both inside and outside the core shroud. This work is a major part of a larger effort to develop a complete system for BWR signal validation. The demonstration plant is the Oyster Creek BWR. Liquid level inside the core shroud is not directly measured during full power operation. This level must be validated using measurements of other quantities and analytic models. Given the available sensors, analytic models for level that are based on mass and energy balances can contain open integrators. When such a model is driven by noisy measurements, the model predicted level will deviate from the true level over time. To validate the level properly and to avoid false alarms, the open integrator must be stabilized. In addition, plant parameters will change slowly with time. The respective model must either account for these plant changes or be insensitive to them to avoid false alarms and maintain sensitivity to true failures of level instrumentation. Problems are addressed here by combining the extended Kalman Filter and Parity Space Decision/Estimator. The open integrator is stabilized by integrating from the validated estimate at the beginning of each sampling interval, rather than from the model predicted value. The model is adapted to slow plant/sensor changes by updating model parameters on-line.

11345 (EPRI-NP—4750-SR, pp 2.103-2.107) **GPU plants for signal validation integration with SPDS.** Walsh, P.S. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

From the other papers presented at this seminar, it is clear that automated signal validation techniques have the potential for numerous applications. Safety Parameter Display Systems (SPDS) will probably receive the highest priority for the applications in the nuclear industry because of their inherent importance to safe operation during unusual or off-normal situations. GPU Nuclear has recently implemented a SPDS at TMI-1 which is integrated with the plant process computer system. We are also developing a system based on the same concepts for Oyster Creek which will be implemented on a new plant computer system to be installed in 1986. In this paper, the author discusses the use in the future. Additionally he discusses what he views as the requirements that need to be fulfilled from a user organization's perspective before this technology can be effectively implemented at an operating plant.

11346 (EPRI-NP—4750-SR, pp 3.3-3.8) **Yankee Rowe SPDS development and its validation and verification.** Candon, D.; Cain, D. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The decision to proceed with EPRI on a prototypical Safety Parameter Display System (SPDS) was made by Yankee Atomic Electric Company management. The general direction to the implementors was to decide from whom would the SPDS be designed, to decide how the SPDS would coincidentally support the twin goals of meeting the regulations and the corporate objective to generate electricity safely and efficiently, and to decide what was known and proven in the arena of computer graphics to minimize cognitive dissonance between the final product SPDS and the operators.

11347 (EPRI-NP—4750-SR, pp 3.11-3.17) **Computerized system for active BWR emergency procedures monitoring.** Cain, D.G. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

A prototype system for automatically tracking oiling water reactor emergency operating procedures is described. The system design and part-task evaluation is presented in conjunction with man versus machine attributes which apply to the new, symptom-based emergency operating procedures.

11348 (EPRI-NP—4750-SR, pp 3.21-3.31) **Disturbance analysis and surveillance systems (DASS) and performance functions validation.** Long, A.B. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

This paper explores the potential benefits and solutions to problems associated with the use of computers in nuclear plants by the operating crew as an aid in making decisions. The need for such computer aids has been widely endorsed in the numerous investigations following the Three Mile Island accident as a means of providing information analysis and integration functions not achievable with conventional control room instrumentation.

11349 (EPRI-NP—4750-SR, pp 3.35-3.63) **Success path monitoring system: a computerized diagnostic aid for nuclear power plant operators.** Johnson, S.E.; Sun, B.K.H. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Program goals are to demonstrate compatibility of DASS/success path monitoring concepts with existing commercial SPDS,

develop and implement a flexible logic representation for plant signal processing and implement and demonstrate on-line common cause failure monitoring and recognition. Critical safety functions and success paths are outlined and the success path design approach is discussed. Elements of the success path design are presented and and common failure monitoring considered.

11350 (EPRI-NP—4750-SR, pp 3.67-3.115) **Display and procedure integration.** Fish, H.C. Jr.; Schilder, J.; Pankratz, D.; Cain, D.G. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The goal of this project was to develop and demonstrate a methodology for integration of displays with procedures. This concept of the methodology is a key feature that distinguishes this project from other safety parameter display system (SPDS) efforts. This project resulted in not only a display set, but a methodology, or a how to do it procedure on a generic basis that could be used by any utility, PWR or BWR, nuclear or fossil, to develop a set of useful computer generated displays that will help an operator in following plant procedures.

11351 (EPRI-NP—4750-SR, pp 4.3-4.16) **EPRI perspectives on core monitoring system development and requirements.** Kim, J.H. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The Power Shape Monitoring System (PSMS) provides site engineers with new capabilities for monitoring and predicting core power distributions. These capabilities can lead to increased plant output as a result of greater operating margins, better load maneuvering, earlier detection of anomalies, and improved fuel reliability.

11352 (EPRI-NP—4750-SR, pp 4.19-4.44) **PWR Core monitoring models.** Peng, C.M.; Ipakchi, A.; Kim, J.H. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The Power Shape Monitoring System (PSMS) is a computer system for on-line monitoring and prediction of reactor cores. It can be used for real-time monitoring of the core power distribution and the margin to the limiting value of the Departure from Nucleate Boiling Ratio (DNBR), load-following core performance analysis, and predictive analysis. The heart of the PSMS consists of a nodal code (NODE-P2/THERM-P) (1) that computes the 3-D core power distribution. This code is coupled to a simplified nodal version of the COBRA-IIIC/MIT-2 thermal-hydraulic model to determine the DNBR (2). Activation of the calculations and review of the results is through user-friendly interactive software than can be tailored to the requirements and capabilities of the different categories of users through table-driven menus.

11353 (EPRI-NP—4750-SR, pp 4.47-4.55) **PSMS as a PWR core monitor.** Blake, R.A. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The concept of a PWR Power Shape Monitoring System (PSMS) represents a vast improvement over the current ex-core monitoring philosophy used at Salem (Units 1 and 2, Westinghouse 4 loop reactors, 17 x 17 fuel). At Public Service Electric and Gas (PSE and G) this improvement is perceived to be a vehicle for greater operating flexibility and increased fuel economy. Upon successful completion of development and testing, it is anticipated that the PWR PSMS will be used at Salem as an on-line core monitor. This paper discusses the PWR monitoring philosophy, and some of the perceived benefits which are anticipated after this implementation. This benefits fall to three general categories; increased operational flexibility, fuel economy, and reduced engineering costs for reload analysis services.

11354 (EPRI-NP—4750-SR, pp 4.59-4.62) **Review of the history of Arkansas Power and Light's involvement in the PWR-SPMS project.** Cypret, O.W. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Arkansas Power and Light's participation in the Power Shape Monitoring System project is outlined. AP & L's involvement included assisting in the development of the systems functional specifications and providing facilities and personnel to perform an on-site test of the system. The conclusion of the project resulted in a system which can, with great accuracy, monitor reactor core conditions and predict core response to basic control parameters.

11355 (EPRI-NP—4750-SR, pp 4.65-4.77) **Use of BWR-PSMS to optimize control rod patterns in BWR.** Frogner, B.; Long, A.B. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The paper represents the rod pattern optimization capabilities within the BWR-PSMS. From an analytical point of view, this is the most advanced and unique feature that is available within the BWR-PSMS. A technical discussion of the methods and the capabilities of the BWR-PSMS rod optimization software is given.

11356 (EPRI-NP—4750-SR, pp 4.81-4.87) **Utility experience with BWR-PSMS.** Bond, G.R. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The BWR Power Shape Monitoring System (BWR-PSMS) has proven to be an effective and versatile tool for core monitoring. GPU Nuclear Corporation's (GPUN) Oyster Creek plant has been involved in the PSMS development since its inception, having been selected by EPRI as the initial demonstration site. Beginning with Cycle 10, Oyster Creek has been applying the BWR-PSMS as the primary core monitoring tool. Although the system has been in operation at Oyster Creek for the past several cycles, this is the first time the PSMS was used to monitor compliance to the plant technical specifications, to guide adherence to vendore fuel maneuvering recommendations and to develop data for certain performance records such as fuel burnup, isotopic accounting, etc. This paper will discuss the bases for the decision to apply PSMS as the fundamental core monitoring system, the experience in implementing the PSMS in this mode, activities currently underway or planned related to PSMS, and potential future extensions and applications of PSMS at Oyster Creek.

11357 (EPRI-NP—4750-SR, pp 4.91-4.128) **Advanced Core Monitoring Framework: an overview description.** Ipakchi, A.; Cain, D. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The Advanced Core Monitoring Framework (ACMF) was conceived to provide on standard software framework operating in a number of different virtual-memory mini-computers within which modules from any of the core monitoring systems (both BWR and PWR) could be readily installed. This would enable a utility to implement, or have implemented, application and standard modules that are available from EPRI or from implemented, application and standard modules that are available form EPRI or from specific vendors. The framework thus enables a smooth transition between different fuel vendors by allowing the use of the most appropriate core monitoring capabilities while providing for the continuity of usage and support. The primary theme of the ACMF is that by carefully defining (standardizing) functions and interfacing with a well defined set of data files, and designing software modules for data file management, user interface and execution control, a framework can be built that allows software plug-in compatibility between a variety of functional packages.

11358 (EPRI-NP—4750-SR, pp 5.3-5.18) **MMS: EPRI developed simulation software.** Divakaruni, S.M.; Sursock, J.P. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The Modular Modeling System (MMS) code is a general purpose simulation software for power plant systems analysis. The development of the code was funded jointly by the Nuclear Power and Coal Combustion Systems Divisions of the Electric Power Research Institute (EPRI) since 1978. MMS will complement existing computer codes in the nuclear and fossil industry in the areas of control system design and analysis, operational and long-term transients evaluations, and scoping safety analysis. This paper will provide an overview of the code development objectives, structure, validation results and the status.

11359 (EPRI-NP—4750-SR, pp 5.21-5.52) **EPRI Plant Analyzer: system description and PWR plant applications.** Ipakchi, A.; Khadem, M.; Peng, C.M.; Chen, H. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

This paper results of an EPRI sponsored project for design and development of a Compact Plant Analyzer. Plant Analyzer is a computer system which offers an interactive and color graphics based environment for operation of dynamic simulation codes such as the MMS. The system can be applied to engineering and training applications in the utility industry. The Plant Analyzer system description and software design are presented. A Pressurized Water Reactor full-plant dynamic model is constructed with the Modular Modeling System (MMS) code package and is interfaced with the Analyzer. A user can interactively operate the plant using mimic control panel displays. Applications of this system to evaluation of Emergency Operating Procedures is presented.

11360 (EPRI-NP—4750-SR, pp 5.55-5.69) **Boiling water reactor Compact Analyzer.** May, R.S.; Cain, D.G. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

A Boiling Water Reactor (BWR) Compact Analyzer, which performs dynamic simulation of the Nuclear Steam Supply System (NSSS) and its Balance of Plant (BOP) components, is currently under development. The simulation model uses the EPRI Modular Modeling System to perform transient analysis on a minicomputer. An IBM-PC/XT personal computer with colorgraphics capabilities will be used both for user control of the simulation on input and color plot and mimic display on output. The demonstration system will be based around a BWR-4 generic plant configuration, but the model and its supporting displays can be adapted to plant-specific configurations.

11361 (EPRI-NP—4750-SR, pp 5.75-5.86) **Simulator fidelity evaluation based on training needs.** Donovan, M.; Sursock, J.P.; Kraje, N.B. (General Physics Corp., Atlanta, GA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

This report summarizes the work to date on a simulator fidelity evaluation project. The development of simulator evaluation criteria, based on a training perspective, is described and a methodology for comparing simulator response to engineering coded data is presented. The measures used to evaluate the simulator's performance are discussed and the results of demonstration analysis are described.

11362 (EPRI-NP—4750-SR, pp 5.89-5.100) **Utility application of simulation software.** Sudduth, A.L. (Duke Power Co., Charlotte, NC). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The purpose of this paper is to discuss dynamic system simulation from the perspective of a successful utility user. In it, four aspects of the issue of utility use of simulation will be addressed: (1) What simulation software is available to utilities which can be of practical assistance with a modest investment in staff and training. (2) To what specific problems can utilities apply the technique of simulation and achieve reasonably cost effective results. (3) What the advantages are of in-house dynamic simulation capability, as opposed to depending on NSSS vendors or consultants. (4) What the prospects are for wider use of dynamic simulation in the utility industry.

11363 (EPRI-NP—4750-SR, pp 6.3-6.13) **Software quality - how is it achieved?.** Straker, E.A. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Although software quality can't be quantified, the tools and techniques to achieve high quality are available. As management stresses the need for definable software quality programs from vendors and subcontractors and provides the incentives for these programs, the quality of software will improve. EPRI could provide the leadership in establishing guidelines for a balanced software quality program and through workshops provide training to utility staff and management on the methods for evaluating the characteristics of quality software. With the more complex systems discussed at this workshop and particularly with the trend toward the use of artificial intelligence, the importance of quality software will grow dramatically.

11364 (EPRI-NP—4750-SR, pp 6.17-6.28) **Communication issues and engineering work stations.** Kriloff, H.Z.; Ganti, N.A. (Boeing Computer Services Co., Tukwila, WA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Computer systems are evolving into collections of processors that work together to execute specific functions. The advent of the new, more-powerful microprocessors have made it possible for the system designer to utilize modules consisting of hardware, software, firmware, and databases integrated building-blocks, and by connecting them to other building-blocks perform new tasks or sequences of operations. The cement that holds together this collection of separately developed modules is the network, an entity steadily expanding to include functions previously performed by operating systems, database managers, display graphics executives, dispatching and other types of application codes. Several computer and communication vendors (IBM/SNA, DEC/DECNET, WANG/WANGNET, AT and T/ The Network Is the Solution, etc.) have realized that, by controlling the structure of the network, they can influence many of the designer's choices, and thereby restrict their future options to implement systems using different architecture structures. Because of this, the user, manager and/or designer of such systems should understand these trade-offs, the longer-term implications of the choices that they are making, and how their options may be restricted when they select a specific network implementation. Therefore, these new network architectures have both opened new options for systems design while making the choice of specific vendor components and increasingly more complex process. This paper is an attempt to outline some of the trends in the technology, and the implications of some of the user choices, now being made, that will influence the designer's options with respect to future system expansion, control and integration. Of course, each system will have many of it's own peculiar requirements that may determine what trade-offs are most significant for a specific case, but some general principles are possible and are developed.

11365 (EPRI-NP—4750-SR, pp 6.31-6.34) **Digital control technology development.** Gopal, R.; Graham, K.F. (Westinghouse Electric, Pittsburgh, PA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Digital control systems have the capability of improving plant availability and reliability if properly implemented. Replacement of analog controllers in operating plants requires special attention in order to successfully accomplish the replacement during a normal length scheduled outage.

11366 (EPRI-NP—4750-SR, pp 6.37-6.51) **Signature analysis techniques for plant monitoring.** Fry, D.N.; Kim, J.H. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

Noise signature analysis can provide diagnostic information in nuclear plant operators to aid them in identification of abnormal trends, thus preventing some unscheduled shutdowns. The application of computer-based automated diagnostic methods based on pattern recognition, artificial intelligence, and expert systems will enable noise analysis to be used in the plant environment without the need for on-site trained noise analysts.

11367 (EPRI-NP—4750-SR, pp 6.55-6.86) **BWR shutdown analyzer using artificial intelligence (AI) techniques.** Cain, D.G. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

A prototype alarm system for detecting abnormal reactor shutdowns based on artificial intelligence technology is described. The system incorporates knowledge about Boiling Water Reactor (BWR) plant design and component behavior, as well as knowledge required to distinguish normal, abnormal, and ATWS accident conditions. The system was developed using a software tool environment for creating knowledge-based applications on a LISP machine. To facilitate prototype implementation and evaluation, a casual simulation of BWR shutdown sequences was developed and interfaced with the alarm system. An intelligent graphics interface for execution and control is described. System performance considerations and general observations relating to artificial intelligence application to nuclear power plant problems are provided.

11368 (EPRI-NP—4750-SR, pp C.3-C.26) **EPRI/CSDL/Northeast Utilities PC-based demonstration of signal validation.** Deutsch, O.L.; Meehan, M.; Divakaruni, M. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

The purpose of this demonstration is to assist utility engineers, management, and plant staff to understand the principles and operation of signal validation using the parity-space decision/estimator methodology and analytic redundancy. The demonstration materials consist of this paper and a program stored on an IBM PC-compatible diskette. The demonstration program calculates the dynamics of a plant subsystem given control inputs that are set interactively by the user. That is, the user controls the plant by keyboard or simulated control board inputs during the course of the demonstration. The program then adds measurement errors to the calculated truth values to simulate the plant sensor readings. The simulated sensor readings are then routed to the signal validation subroutine where fault-detection and identification (FDI) decisions are made and validated estimates of plant variables are generated. The user has control over the measurement errors and a signal validation parameter via keyboard or simulated control board inputs. The results are displayed in a variety of formats on keyboard control.

11369 (EPRI-NP—4750-SR, pp C.29-C.43) **PC-based demonstration of BWR reactor vessel level and pressure signal validation.** Ornedo, R.S. Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920023. (CONF-850260—).

From EPRI seminar on nuclear power plant safety control technology; Palo Alto, CA, USA (4 Feb 1985).

This paper describes the personal computer (PC)-based demonstration of a computer program to automate the validation of the BWR reactor vessel level and pressure signals. The objective of this demonstration is to show how the signal validation technology can be applied to these specific BWR applications. BWR utility engineers, management, and plant staff are encouraged to use this demonstration to help them better understand the principles and operation of the signal validation methodology. The program may be run on an IBM PC or on any IBM-compatible machines. It is designed to be self-paced and user-friendly.

11370 **(EPRI-NP—4855) Survey of the literature applicable to two-phase natural circulation flows in the hot leg of a PWR: Final report.** Valenzuela, J.A.; Crowley, C.J.; Wallis, G.B. (Creare R and D, Inc., Hanover, NH (USA)). Oct 1986. 155p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920133.

This report reviews the two-phase flow literature relevant to the natural circulation flow in the hot leg of a pressurized water nuclear reactor during a small break loss of coolant accident. The phenomena of interest in two-phase naural circulation flows are numerous and complex. Three technical areas were identified for individual review in this report: gas-liquid flows in straight pipes; gas-liquid flows in bends; and two-phase natural circulation in reactor geometries. The literature has been surveyed, findings summarized, and suggestions have been made as to where the findings may influence thinking and model development for the reactor situation.

11371 **(EPRI-NP—4967M) The source term experiments project deposition sample characterization: Interim report.** Schlenger, B.J.; Jackson, W.D.; Herceg, J.E.; Simms, R.; Dunn, P.F. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 51p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87004111.

A series of four experiments aimed at characterizing the radiological source term associated with postulated severe light water reactor accidents has been conducted at Argonne National Laboratory's TREAT Facility. The experiments were designed to provide dta regarding the physicochemical properties, near the point of origin, of the biologically important volatile fission products released early in such accidents. The experimental vehicles were equipped to capture representative fission products released from fuel rods undergoing severe cladding degradation in a steam environment. Test conditions of pressure, fuel heatup rate, and steam flow were selected to simulate conditions predicted for hypothetical reactor accident sequences. One of the main components of the experimental vehicle's aerosol characterization system, common to all four tests, was a sample tree. It served to suspend coupons composed of a variety of materials, some typical of reactor structures, into the fission-product-laden steam flow. These coupons collected particulates and condensing vapors. Coupons frome ach of the four tests have been examined using scanning electron microscopy and associated energy dispersive x-ray analysis. The results of these initial sample examinations are presented. They are preceeded by a brief description of the test series and the experimental vehicle. Also included is a discussion of planned posttest examinations of other aerosol characterization system components and the test fuel as well as further examinations of the sample tree coupons. Results of the additional examinations thermal-hydraulic data, and interpretation of the information for each test will be included in future reports.

11372 **(EPRI-NP—4974) Evaluation of empirical aerosol correlations: Final report.** Otter, J.M.; Vaughan, E.U. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 102p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920183.

Novel correlation and scaling methods developed to replace mechanistic analyses of aerosol behavior in the Modular Accident Analysis Program (MAAP) code are reviewed and evaluated as to their present and potential reliability. The initial version of the correlation procedure is found to suffer from inaccurate scaling and some faults in details of implementation. Comparisons with aerosol experiments are made that show unimpressive performance by this version as implemented. An improved version is found to be based on much more satisfactory scaling and to compare favorably with a limited range of experiments. Moreover, its performance is reasonably competitive with mechanistic analyses for two practical scenarios. It is concluded that the initial version should be superseded by the improved version, which is potentially quite valuable but should be tested against a wider range of experimental results that are available or are becoming available. A treatment of hygroscopic aerosols in steam atmospheres proposed for use in MAAP is also examined. It is found to be quite interesting theoretically and to survive comparison with one series of experiments, but alternatives are not excluded and the range of validity of some of its assumptions is unclear.

11373 **(EPRI-NP—4976) Transient failure of zircaloy cladding: State-of-the-art study and model development: Final report.** Rashid, Y.R. (Anatech International Corp., La Jolla, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 32p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920185.

A state of the art study of transient failure of zircaloy reveals that a wide range of failure models exist, and their use in fuel analysis depends upon the type of application. Licensing analyses, for example, employ highly simplified criteria that depict cladding rupture in terms of a single response variable, usually the nominal circumferential stress, as function of temperature; while fuel behavior analyses use more detailed models with varying levels of sophistication. Some of these models, however, are ill-suited for detailed fuel rod analysis computer codes because of their dependence on case-specific parameters; others are limited in their utility because of inherent deficiencies in their theoretical treatment of the phenomena involved. Based on this study, a new zircaloy transient failure model is developed that takes account of the important variables involved in transient phenomena, namely, heating rate, strain rate, temperature, true stress, true strain, and prior condition of the cladding material. The model is particularly suited for detailed fuel rod analysis and thus was implemented in the FREY code.

11374 **(FEI—1644) Calculational method for coefficient of heat transfer to coolant flow in dryout and rewetting.** Sapankevich, A.P.; Dolgov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700448.

A test loop was used to investigate heat transfer in the process of post-accident cooling of nuclear reactor fuel assemblies. Obtained cooling rate history for regimes of dryout heat removal, boiling and forced convection is used to determine heat transfer coefficient. The method saggested permits to obtain total characteristics of the cooling process without using thermophysical parameters of separate elements of the system under investigation. 5 refs.; 1 fig.

11375 **(GA-A—18643) MHTGR licensing approach and plant response to off normal events.** Neylan, A.J.; Silady, F.A. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1986. Contract AC03-84SF11963. 19p. (CONF-8610160—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001317.

From IAEA technical committee meeting on gas-cooled reactors and their applications; Juelich, F.R. Germany (20 Oct 1986).

The MHTGR design meets stringent top-level regulatory and user safety requirements that require that the normal and off-normal operation of the plant not disturb the public's day-to-day activities. Quantitative, generic top-level regulatory criteria have been specified from US NRC and EPA sources to guide the design. A probabilistic risk assessment has been utilized to select licensing basis events that cover a wide spectrum of events. The MHTGR fuel has been designed to limit the primary circuit activities to levels that, even if completely released, are within those allowed by 10CFR100. The focus of the safety approach has then been centered on retaining the radionuclide inventory within the fuel by removing core heat, controlling chemical attack, and by controlling heat generation. The core geometry, core power, core power density, heat removal geometry, and heat sinks are designed to provide passive core temperatures during accidents. To limit the potential for chemical attack of the MHTGR core, the primary coolant boundary is designed to make large ingress of air and water very unlikely. Furthermore, the fuel particle coatings are highly impervious to oxidizing agents that do enter the primary coolant. The core heat generation is controlled by the large negative temperature coefficient and by insertion of control material to maintain a subcritical core configuration during the span of the accidents.

11376 **(INIS-mf—10525) Chernobyl nuclear accident and its consequences.** (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 19 Sep 1986. 78p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87700443.

An AAEC Task Group was set up shortly after the accident at the Chernobyl Nuclear Power Plant to monitor and evaluate initial reports and to assess the implications for Australia. The Task Group issued a preliminary report on 9 May 1986. On 25-29 August 1986, the USSR released details of the accident and its consequences and further information has become available from the Nuclear Energy Agency of OECD and the World Health Organisation. The Task Group now presents a revised report summarising this information and commenting on the consequences from the Australian viewpoint.

11377 **(NUREG—0683-Suppl.2) Programmatic environmental impact statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979 accident, Three Mile Island Nuclear Station, Unit 2 (Docket No. 50-320): Draft.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation; GPU Nuclear Corp., Middletown, PA (USA)). Dec 1986. 132p. NTIS, PC A07/MF A01 - GPO. File Number TI87900404.

In accordance with the National Environmental Policy Act and the Commission's implementing regulations and its April 27, 1981 Statement of Policy, the Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979, accident Three Mile Island Nuclear Station, Unit 2 NUREG-0683 (PEIS) is being supplemented. This draft supplement updates the environmental evaluation of accident-generated water disposal alternatives published in the PEIS, utilizing more complete and current information. Also, the draft supplement includes a specific environmental evaluation of the licensee's recently submitted proposal for water disposition.

11378 **(NUREG—0829-Final) Integrated plant safety assessment: Systematic Evaluation Program, San Onofre Nuclear Generating Station, Unit 1 (Docket No. 50-206): Final report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1986. 597p. NTIS, PC A25/MF A01 - GPO. File Number TI87900395.

The Systematic Evaluation Program was initiated in February 1977 by the US Nuclear Regulatory Commission to review the designs of older operating nuclear reactor plants to reconfirm and document their safety. The review provides: (1) an assessment of how these plants compare with current licensing safety requirements relating to selected issues; (2) a basis for deciding on how these differences should be resolved in an integrated plant review; and (3) a documented evaluation of plant safety. This report documents the review of San Onofre Nuclear Generating Station, Unit 1, operated by Southern California Edison Company. The San

Onofre plant is one of ten plants reviewed under Phase II of this program. This report indicates how 137 topics selected for review under Phase I of the program were addressed. Equipment and procedural changes have been identified as a result of the review. This report will be one of the bases in considering the issuance of a full-term operating license in place of the existing provisional operating license. This report also addresses the comments and recommendations made by the Advisory Committee on Reactor Safeguards in connection with its review of the draft report issued in April 1985.

11379 (NUREG—1137-Suppl.4) **Safety evaluation report related to the operation of Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1986. 196p. NTIS, PC A09/MF A01 - GPO. File Number TI87900417.

In June 1985, the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-1137) regarding the application of Georgia Power Company, Municipal Electric Authority of Georgia, Oglethorpe Power Corporation, and City of Dalton, Georgia, for licenses to operate the Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425). Supplement 1 to NUREG-0737 was issued by the staff in October 1985, Supplement 2 was issued in May 1986, and Supplement 3 was issued in August 1986. The facility is located in Burke County, Georgia, approximately 26 miles south-southeast of Augusta, Georgia, and on the Savannah River. This fourth supplement to NUREG-1137 provides recent information regarding resolution of some of the open and confirmatory items that remained unresolved at the time the Safety Evaluation Report was issued. This supplement also discusses some new items.

11380 (NUREG—1197) **Advanced Light Water Reactor Program: Program management and staff review methodology.** Moran, D.H. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Review and Oversight). Dec 1986. 67p. NTIS, PC A04/MF A01 - GPO. File Number TI87900415.

This report summarizes the NRC/EPRI coordinated effort to develop design requirements for a standardized advanced light water reactor (ALWR) and the procedures for screening and applying new generic safety issues to this program. The end-product will be an NRC-approved ALWR Requirements Document for use by the nuclear industry in generating designs of LWRs to be constructed for operation in the 1990s and beyond.

11381 (NUREG/CP—0070, pp 145-159) **Reserve strength as a measure of fragility.** LaPay, W.S.; Bishop, B.A.; Chay, S.C. (Westinghouse P.E.D., Pittsburgh, PA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

It is well known that most components in a nuclear power plant have significant reserve strength and will provide an insignificant contribution to the probability of a major accident. However, when a utility undertakes a probabilistic risk assessment or systematic evaluation program, all components in the plant are normally considered of equal importance and a program of significant scope and expenditures is required to address them all. In this paper, a method to quantify this component reserve strength is presented. Its use allows the utility to focus its resources on those areas and components which are critical to overall plant safety. In performing a probabilistic risk assessment, the key question which must be addressed is: What is the probability that the critical applied stress will exceed the ultimate capacity of the component? The answering of this question is referred to as fragility analysis. If reserve strength, which is the inherent capability of a structural component to accommodate applied stresses beyond its conservative strength limits. can be quantified by its mean value and its associated uncertainties, then this reserve strength can be used to indicate the structural fragility of any component. The reserve strength method presented in this paper provides a statistical approach for estimating the probability of failure of a component using the factors and uncertainties associated with the two key components of reserve strength, namely, applied stress and ultimate strength (or capacity). For a plant piping/support system, typical stress factors include damping, seismic loading, and method of analysis.

11382 (NUREG/CP—0070, pp 160-174) **Component fragility and its application to equipment assemblies.** Sharma, S.S.; Tseng, W.S. (Bechtel Power Corp., San Francisco, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

This paper discusses some of the difficulties that may exist in the application of component fragility data when those components are part of a larger system. Large systems such as switchgear, motor control centers, and control panels modify the performance of individual components by introducing their own dynamic characteristics as well as non-linearities. Therefore, it is important that fragility data available for individual devices and components be supplemented by test information obtained for systems and assemblies. The paper presents some examples from existing test data to demonstrate the effect of panel non-linearities on the performance of individual components in the systems. It further discusses various parameters such as frequency content of input motion, dynamic characteristics of panels, orientation and mounting of devices in the panel, and their effect on the applicability of fragility data of individual components.

11383 (NUREG/CP—0070, pp 176-185) **Effects of relay chatter in seismic probabilistic safety analysis.** Reed, J.W.; Shiu, K.K. (Jack R. Benjamin & Associates, Inc., Mountain View, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

In the Zion and Indian Point Probabilistic Safety Studies, relay chatter was dismissed as a credible event and hence was not formally included in the analyses. Although little discussion is given in the Zion and Indian Point PSA documentation concerning the basis for this decision, it has been expressed informally that it was assumed that the operators will be able to reset all relays in a timely manner. Currently it is the opinion of many professionals that this may be an oversimplification. The three basic areas which must be considered in addressing relay chatter include the fragility of the relays per se, the reliability of the operators to reset the relays and finally the systems response aspects. Each of these areas is reviewed and the implications for seismic PSA are discussed. Finally, recommendations for future research are given.

11384 (NUREG/CP—0070, pp 186-193) **Formulation of a fragility program.** Shipway, G.D. (Wyle Labs., Norco, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

The formulation of a fragility test program should include the review of a series of questions and trade offs. The answers, or at least tentative answers, to these questions will guide the program approach. This paper will share the questions and the thinking that went into the formulation of a current test program. Included in the questions are: 1) grouping and priority, 2) mounting and anchoring, 3) operation and functional anomalies, 4) instrumentation, 5) excitation waveforms, 6) test sequence and number of samples, and 7) data review and analysis. The approach selected for the demonstration program will be outlined.

11385 (NUREG/CP—0070, pp 195-216) **Will the real fragility please stand up?.** Smith, P.D. (EQE Inc., San Francisco, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

This paper is written from the perspective of the author's experience with the Seismic Safety Margins Research Program (SSMRP). The SSMRP is the only probabilistic risk assessment (PRA) that was developed by a team that had all of the technical disciplines required to execute a seismic PRA within a single organization (Lawrence Livermore Laboratory) and by a team that emphasized seismic rather than PRA considerations, including issues on fragility. The point is made that data on the performance of in-

dustrial facilities in past earthquakes have been largely overlooked in the current state-of-the-art of seismic fragility.

11386 (NUREG/CP—0070, pp 217-226) **Review of seismic probabilistic risk assessment and the use of sensitivity analysis.** Shiu, K.K.; Reed, J.W.; McCann, M.W. Jr. Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

This paper presents results of sensitivity reviews performed to address a range of questions which arise in the context of seismic probabilistic risk assessment (PRA). These questions are the subject of this paper. A seismic PRA involves evaluation of seismic hazard, component fragilities, and system responses. It is often difficult to examine seismic PRA results and derive useful insights from them to detailed sensitivity studies are absent. In a seismic PRA, sensitivity evaluations can be divided into three areas: hazard, fragility, and system modeling. As a part of the review of a standard boiling water reactor seismic PRA which was performed by General Electric, a reassessment of the plant damage states frequency and a detailed sensitivity analysis were conducted at Brookhaven National Laboratory. Seismic event trees and fault trees were developed to model the different system and plant accident sequences. Several conclusions can be drawn from the results of the reassessment and the sensitivity analyses. First, it is clear that in order to gain useful insights from a seismic PRA, systematic and rigorous sensitivity studies are necessary. Second, perturbation of the hazard curves yields significant changes in the final results. Third, the percentage of contribution to plant damage state frequency from low ground accelerations can be dominated by the characterization of the left-hand-tail of the fragility curve.

11387 (NUREG/CP—0070, pp 227-239) **Significance of the analytical forms of fragility curves.** Goodman, J.; Hadjian, A.H. (Bechtel Power Corp., Norwalk, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

Sensitivity analysis of the core melt probability to the analytical forms of the plant fragility is provided. Major parameters of the fragility curve affecting the core damage probability are discussed. Using algebra of fragilities it is demonstrated how analytical forms of component fragilities shape up the plant fragility and determine its parameters.

11388 (NUREG/CP—0070, pp 240-244) **Seismic/dynamic fragility and systems interaction study at Indian Point - 3.** Pal, A.C. (New York Power Authority, White Plains). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

Systems Interaction (SI) Study for Indian Point Nuclear Power Plant, Unit No. 3 was undertaken per advice of the Advisory Committee on Reactor Safeguards primarily to determine the effect of failure of non safety-related components and systems on safety-related items and plant safety itself. In the present paper it is shown that a predominant number (95%+) of postulated SI's attributed to a seismic event equivalent to SSE, have extremely low probabilities of occurrence if seismic/dynamic fragilities of the components/systems were taken into consideration.

11389 (NUREG/CP—0070, pp 22-32) **Comments on seismic fragility of nuclear power plant components.** Kennedy, R.P.; Campbell, R.D. (NTS/Structural Mechanics Associates, Newport Beach, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

Recent advances in the prediction of seismic hazard have resulted in concern that some nuclear power plant sites could experience seismic events in excess of their design bases. This concern, along with the considerable interest that has arisen from interpretations of probabilistic risk assessments, has resulted in significant professional activity in the prediction of fragilities of structures and equipment. Several programs sponsored by utilities, regulators and EPRI are addressing many of the aspects of seismic fragility. This paper discusses the current state-of-the-art in fragility prediction, fragility data sources, relative seismic ruggedness of power plant components, problem areas in fragility prediction, and suggested future work in fragility testing.

11390 (NUREG/CP—0070, pp 33-47) **Safety capacity concepts for nuclear plant equipment qualification.** Kana, D.D. (Southwest Research Institute, San Antonio, TX). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

Safety capacity concepts are considered for use in generalization of nuclear plant equipment qualification procedures. The objective is an eventual increase of efficiency and reduction of cost for the equipment qualification process. A general definition of fragility is given and its relationship with several currently considered safety capacity concepts is described. These include equipment fragility as defined in Standard IEEE 344, probabilistic fragility, generic equipment ruggedness, and safety margin. Typical parameters for determination of the respective safety capacities are included. The general fragility definition is recognized to be applicable to all types of environments. However, herein emphasis is on dynamic, and particularly on seismic effects on equipment. Recommendations for further research and development of these concepts are discussed.

11391 (NUREG/CP—0070, pp 48-61) **Elements of fragility models.** Goodman, J.; Hadjian, A.H. (Bechtel Power Corp., Norwalk, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

In order to provide a common basis for conducting uniform fragility analyses, the following five basic elements of fragility models are identified and discussed: risk presentation, failure modes, analytical form of the fragility curve, evaluation of fragility curve parameters and assembly of component fragilities into a system or a plant fragility. The importance of every element of the fragility model is demonstrated and its impact on core melt probability for a generic nuclear power plant is discussed.

11392 (NUREG/CP—0070, pp 63-75) **Obtaining reliable quality data from fragility tests.** Hendricks, J.R.; Rusen, W.M.; Rettig, D.P. (Farwell & Hendricks, Inc., Milford, OH). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

The parameters discussed in this paper are the same as those present in normal seismic qualification testing. These parameters behave differently in high level acceleration tests and their contribution in providing unreliable data is of major concern since there is a significant difference. These parameters need to be considered in developing methodology guidelines for future fragility standards. In seismic qualification testing, a predefined series of tests are performed and measured against a set of acceptance criteria. The response spectra generally has a peak acceleration of between 3-10 g's at a 2% damping value for the Design Basis Event (Safe Shutdown Earthquake). Fragility level testing has minimum starting point of 10 g's at 2% damping and is generally 20 g's at 2% damping. The dynamic characteristics of the simulated earthquake and the corresponding simulator hardware interfaces are the parameters discussed. There are two major parameter contributions in obtaining unreliable data. The first parameter is test specimen system hardware nonlinearities. The second major variable is electronic signal saturations.

11393 (NUREG/CP—0070, pp 76-91) **Impact on fragility level test by various types of multiaxis excitation.** Cory, J.F. Jr.; Hendricks, J.R.; Rusen, W.M.; Rettig, D.P. (Structural Dynamics Research Corp., Milford, OH). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

The purpose of this paper is to provide input guidelines in evaluating various types of multiaxis excitation on fragility level testing of electronic devices. There are many variables that must be

considered in establishing fragility test programs. This paper is limited to the discussion of three types of multiaxis excitations. This evaluation consists of dependent biaxial tests, independent biaxial tests and triaxial tests. The test inputs were generated by independent random noise sources with a Gaussian distribution. The test sample was a two bay electrical cabinet. This cabinet was loaded with dummy weights to simulate installed instrumentation. The problem of fragility testing becomes more complex as the response spectra increases. Compounding this problem is the number of axes of excitation. The data for the comparisons include the peak accelerations from the response accelerometers and the total time duration accelerometer. Selected data is presented in overlaying plots and tabulated in normalized form. The normalized form is triaxial test data set to unity (one).

11394 (NUREG/CP—0070, pp 92-99) **Evaluation of equipment anchorage capacities.** Tseng, T.M.; Anagnostis, S.; Djordjevic, W.; Stevenson, J.D. (Stevenson & Associates, Topsfield, MA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

One important parameter in determining the overall dynamic fragility of equipment is the capacity of the base anchorage. This paper deals with the subject of how to evaluate anchorage capacity in a more reasonable and straightforward manner. An interactive software package has been developed to evaluate anchorage pattern using a portable microcomputer (IBM PC or compatible.) The purpose of this software package configuration is to provide existing plants with the means of immediately determining the capacities of in-place equipment anchorages. In addition, the software package allows new design postulation in the field for nonconforming anchorage patterns. All evaluations are stored on disk and may be printed out at day's end. The solution algorithm is of interest in that difficulties in anchorage evaluation usually arise from estimating the state of equilibrium and in estimating the effective stiffness of the anchorage tensile elements and the bearing area. A solution algorithm utilizing the lower bound theorem of plasticity and linear programming without the need to estimate anchorage or bearing effective stiffness is presented in the paper. The solution technique is found to be systematic and efficient, and therefore is ideal for computer implementation.

11395 (NUREG/CP—0070, pp 100-109) **Seismic fragility results during EPRI's aging/seismic research.** Gleason, J.F. (Wyle Labs., Huntsville, AL). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

EPRI has sponsored research on the effects of aging on seismic performance of safety-related equipment for the last six years. During this research a total of 4653 electrical equipment items have been seismically tested to seismic levels in excess of 10g ZPA, using random multifrequency input with biaxial and triaxial methods. Both aged and unaged equipment types were tested in order to determine whether there are any seismic performance differences between them. The aged devices were both naturally and artificially aged. The devices, assembled and mounted simulating typical installation in nuclear power plants, were subjected to six seismic test response spectra, the greatest of which enveloped spectra used by the laboratory for most previous equipment tests for plant specific applications. Thus both aging and seismic stresses were purposely more severe than typically required for equipment qualification. In spite of the severe seismic levels achieved in the simulations, a fragility level was found on only two percent of the components. The component types experiencing fragility were pressure switches, relays (general purpose and time delay), contactors, lamps, electronic alarms, switches (limit, rotary, and snap acting), a fuse block, and mounting brackets on several equipment types. Fragility levels were not reached for transistors, diodes, integrated circuits, SCR, resistors, capacitors, P.C. boards, connectors, terminal blocks, fuses, transformers, solenoid valves, RTD, pressure transmitters, power supplies, meters, control stations, motors, circuit breakers (molded case), or inductors.

11396 (NUREG/CP—0070, pp 110-122) **Generic seismic qualification of equipment using existing test data.** Smith, C.B.; Merz, K.L. (ANCO Engineers, Inc., Culver City, CA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

This paper presents the results of the first phase of an ongoing program sponsored by the Electric Power Research Institute with overall objective of demonstrating the seismic adequacy of as much nuclear power plant equipment as possible by means of collating and evaluating existing seismic qualification test data. These data are used to construct ruggedness spectra below which equipment in operating plants designed to earlier earthquake criteria would be generically qualified.

11397 (NUREG/CP—0070, pp 123-128) **Review of valve-operator fragility results.** Bhargava, D.; Muni, N.; Feldman, S.M. (Stone & Webster Engineering Corp., Cherry Hill, NJ). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

In BWR nuclear plants, a large number of motor-operated valves are located inside the Reactor Building or on piping attached to it, and are therefore affected by the suppression pool hydrodynamic loads, in addition to seismic loads. Since the valve operators are used industry-wide, and initial results of piping analyses from various BWR plants showed significantly high levels of accelerations due to these dynamic loads, a program to qualify the actuators to their fragility limits was developed and carried out. Also, these dynamic loads are caused by a large number of hydrodynamic events which translate into thousands of stress cycles that can contain frequency content typically up to 100 Hz. Therefore, the program was designed such that if an anomaly were to occur at any stage of the testing, the tests completed up to that stage would be meaningful. The completed tests would allow setting specific qualification limits for various dynamic loading contributors and combinations, with consideration of magnitudes, stress cycles and frequency content. These limits can be later reconciled with the final accelerations (corresponding to these loads) obtained from the as-built piping analyses. The material presented herein discusses the dynamic qualification requirements, development of a fragility test method and its rationale, test plan and test results with observed anomalies. The tests identify qualification limits for these actuators, which are applicable provided certain corrective actions are taken.

11398 (NUREG/CP—0070, pp 129-144) **Overview of relay and auxiliary component seismic fragility.** Kunkel, C.E. Jr.; Detwiler, J.W. (BBC Brown Boveri Inc., Spring House, PA). Aug 1985. NTIS, PC A13/MF A01 - GPO. File Number TI86001761. (BNL-NUREG—51924; CONF-8506188—).

From Fragility workshop; Upton, NY, USA (5 Jun 1985).

Documentation from forty-eight seismic tests of switchgear assemblies contains a large amount of component fragility/ruggedness data. Much of the data is in rigorous detail but extraction and summarization into a usable format has not been accomplished. In many cases, the test documentation provides sufficient data to serve as a direct source of component qualification results as well as fragility data. In all cases the data expands the authors knowledge of component seismic capability and frequently it is a useful augmentation to other data for increased confidence in performance predictions. The complexities introduced by variations in testing technique and performance requirements underscore the need for a detailed understanding of the functions and limitations of critical components during vibration.

11399 (NUREG/CP—0081) **Transactions of the Fourteenth Water Reactor Safety Information Meeting.** Weiss, A.J. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). 1986. 293p. (CONF-8610135—Summs.). NTIS, PC A13/MF A01 - GPO. File Number TI87900064.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This report contains summaries of papers of reactor safety research to be presented at the 14th Water Reactor Safety Information Meeting held at the National Bureau of Standards in Gaithersburg, Maryland, October 27-31, 1986. The summaries briefly describe the programs and results of nuclear safety research sponsored by the Office of Nuclear Regulatory Research, USNRC. Summaries of invited papers concerning nuclear safety issues are included from the Office of Nuclear Reactor Regulation, USNRC, in addition to summaries of invited papers that cover the highlights of reactor safety research conducted by the Department of Energy (DOE), the electric utilities through the Electric Power Research Institute (EPRI), the nuclear industry, and the research of government and industry in Europe and Japan. The summaries have been compiled in one report to provide a basis for meaningful discussion and information exchange during the course of the meeting, and are given in the order of their presentation in each session.

11400 **(NUREG/CR—4016-Vol.2) Application of SLIM-MAUD: A test of an interactive computer-based method for organizing expert assessment of human performance and reliability: Volume 2, Appendices.** Spettell, C.M.; Rosa, E.A.; Humphreys, P.C.; Embrey, D.E. (Brookhaven National Lab., Upton, NY (USA); London School of Economics and Political Science (UK). Dept. of Social Psychology; Human Reliability Associates Ltd., Parbold, Lancashire (UK); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1986. Contract AC02-76CH00016. 218p. (BNL-NUREG—51828-Vol.2). NTIS, PC A10/MF A01 - GPO. File Number TI87003422.

The US Nuclear Regulatory Commission (NRC) has been conducting a multiyear research program to investigate different methods for using expert judgments to estimate human error probabilities (HEPs) in nuclear power plants. One of the methods investigated, derived from multi-attribute utility theory, is the Success Likelihood Index Methodolocy implemented through Multi-Attribute Utility Decomposition (SLIM-MAUD). This report describes a systematic test application of the SLIM-MAUD methodology. The test application is evaluated on the basis of three criteria: practicality, acceptability, and usefulness. Volume I of this report represents an overview of SLIM-MAUD, describes the procedures followed in the test application, and provides a summary of the results obtained. Volume II consists of technical appendices to support in detail the materials contained in Volume I, and the users' package of explicit procedures to be followed in implementing SLIM-MAUD. The results obtained in the test application provide support for the application of SLIM-MAUD to a wide variety of applications requiring estimates of human errors.

11401 **(NUREG/CR—4499) CONTAIN code calculations of the effects on the source term of CsI to I_2 conversion due to severe hydrogen burns.** Valdez, G.D. (Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1986. Contract AC04-76DP00789. 46p. (SAND—86-7108). NTIS, PC A03/MF A01 - GPO. File Number TI87004001.

Preliminary experiments have been conducted at Sandia National Laboratories simulating degraded-core accidents. One notable result of these preliminary tests is the observation of the conversion of cesium iodide (CsI) to its elemental form (I_2) following a hydrogen burn. To evaluate some of the implications of the iodide conversion for the source term, computational simulations of the Surry TML and TMLB′ accident sequences using experimental data on near-stoichiometric burns were conducted with the CONTAIN code. CONTAIN is the NRC's general-purpose computer code for modeling containment response to a severe accident. The results provide qualitative insights on a few of the more important sensitivities of the source term to the form of radioactive iodine in containment, and can be used to guide further experimental and theoretical developments in assessing the consequences of iodide conversion.

11402 **(NUREG/CR—4550-Vol.7) Analysis of core damage frequency from internal events: Zion Unit 1.** Wheeler, T.A. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 103p. (SAND—86-2084-Vol.7). NTIS, PC A06/MF A01 - GPO. File Number TI87003410.

The Review and Evaluation of the Zion Probabilistic Safety Study (NUREG/CR-3300) represents an analysis of the risk profile at Zion based on the plant status as of 1982. This report reevaluates the dominant accident sequences of NUREG/CR-3300 within the context of changes in plant configurations, operational procedures, and general safety issues. This analysis is restricted to the set of accident sequences in NUREG/CR-3300, and does not investigate potentially new dominant sequences.

11403 **(NUREG/CR—4674-Vol.1) Precursors to potential severe core damage accidents, 1985, a status report: Main report and Appendixes A, B and C.** Minarick, J.W.; Harris, J.D.; Austin, P.N.; Cletcher, J.W.; Hagen, E.W. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Dec 1986. Contract AC05-84OR21400. 238p. (ORNL/NOAC—232/V1). NTIS, PC A11/MF A01 - GPO. File Number TI87003939.

As reported in licensee event reports (LERs), 63 operational events that occurred at commercial light-water reactors during 1985 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of the work presented in NUREG/CR-2497 and NUREG/CR-3591, which evaluated the 1969 to 1981 events. The current study incorporates improvements that evolved since issue of the earlier reports, primarily in the areas of plant-class modeling and the review of reactor-trip-related events, in the assessment of the operational events that occurred during 1985. The report sequentially discusses (1) the general rationale for this study, (2) the program methods for LER review and documentation, (3) the development of event-tree-based core damage models, (4) the use of the conditional probability of subsequent severe core damage estimates to rank precursor events, and (5) the application of program results to current concerns pertaining to nuclear power plant risk assessment.

11404 **(NUREG/CR—4674-Vol.2) Precursors to potential severe core damage accident, 1985: A status report: Appendices D, E, and F.** Minarick, J.W.; Harris, J.D.; Austin, P.N.; Cletcher, J.W.; Hagen, E.W. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Dec 1986. Contract AC05-84OR21400. 680p. (ORNL/NOAC—232/V2). NTIS, PC A99 - GPO. File Number DE87003936.

This document contains: operational event listings; precursor documentation; and licensee event reports associated with precursors.

11405 **(NUREG/CR—4680) Heat and mass release for some transient fuel source fires: A test report.** Nowlen, S.P. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1986. Contract AC04-76DP00789. 58p. (SAND—86/0312). NTIS, PC A04/MF A01 - GPO. File Number TI87003218.

Nine fire tests using five different trash fuel source packages were conducted by Sandia National Laboratories. This report presents the findings of these tests. Data reported includes heat and mass release rates, total heat and mass release, plume temperatures, and average fuel heat of combustion. These tests were conducted as a part of the US Nuclear Regulatory Commission sponsored fire safety research program. Data from these tests were intended for use in nuclear power plant probabilistic risk assessment fire analyses. The results were also used as input to a fire test program at Sandia investigating the vulnerability of electrical control cabinets to fire. The fuel packages tested were chosen to be representative of small to moderately sized transient trash fuel sources of the type that would be found in a nuclear power plant. The highest fire in-

tensity encountered during these tests was 145 kW. Plume temperatures did not exceed 820°C.

11406 **(NUREG/CR—4761) Small break critical discharge: The roles of vapor and liquid entrainment in a stratified two-phase region upstream of the break.** Schrock, V.E.; Revankar, S.T.; Mannheimer, R.; Wang, C.H. (Lawrence Berkeley Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Dec 1986. Contract AC03-76SF00098. 188p. (LBL—22024). NTIS, PC A09/MF A01 - GPO. File Number TI87003860.

The main objective of this research program was to perform an experimental investigation on the phenomena of two-phase critical flow through small break from a horizontal pipe which contained a stratified two phase flow. Stagnation conditions investigated were saturated steam-water, and air-cold water at pressures ranging from 0.37 MPa to 1.07 MPa. The small breaks employed were cylindrical tubes of diameters 3.96 mm, 6.32 mm, and 10.1 mm with sharp-edged entrance. For breaks resulting from a small hole in a primary coolant pipe or in a small pipe, a sharp-edged orifice or a sharp-edged tube can be the approximation.

11407 **(NUREG/CR—4792-Vol.3) Probability of failure in BWR reactor coolant piping: Probabilistic treatment of stress corrosion cracking in 304 and 316NG BWR piping weldments.** Harris, D.O.; Dedhia, D.D.; Eason, E.D.; Patterson, S.D. (Failure Analysis Associates, Palo Alto, CA (USA)). Dec 1986. Contract W-7405-ENG-48. 198p. (UCID—20914-Vol.3). NTIS, PC A09/MF A01 - GPO. File Number TI87003765.

The purpose of this report is to describe recent expansions of the previously developed PRAISE code to include recent information to make it more applicable to probabilistic analysis of sensitized weldments in BWR piping. The expansions of PRAISE are concentrated in three areas· (1) probabilistic treatment of stress corrosion crack initiation in 304 and 316NG; (2) probabilistic treatment of residual stresses; and (3) benchmarking with field observations of cracking in 304 BWR piping weldments. This expanded version of PRAISE is called PRAISE-CC, and is a significant extension of earlier versions, which considered only piping failures due to the growth of pre-existing crack-like weld defects. PRAISE-CC retains the earlier PRAISE capabilities.

11408 **(ORNL/M—260) Safety analysis report for the National Low-Temperature Neutron Irradiation Facility (NLTNIF) at the ORNL Bulk Shielding Reactor (BSR).** Coltman, R.R. Jr.; Kerchner, H.R.; Klabunde, C.E.; Richardson, S.A. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87002877.

This report provides information concerning: the experiment facility; experiment assembly; instrumentation and controls; materials; radioactivity; shielding; thermodynamics; estimated or measured reactivity effects; procedures; hazards; and quality assurance. (JDB)

11409 **(SAND—86-2129C) Analysis of Peach Bottom station blackout with MELCOR.** Dingman, S.E.; Cole, R.K.; Haskin, F.E.; Summers, R.M.; Webb, S.W. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 26p. (CONF-8610135—40). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002487.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A demonstration analysis of station blackout at Peach Bottom has been performed using MELCOR and the results have been compared with those from MARCON 2.1B and the Source Term Code Package (STCP). MELCOR predicts greater in-vessel hydrogen production, earlier melting and core collapse, but later debris discharge than MARCON 2.1B. The drywell fails at vessel breach in MELCOR, but failure is delayed about an hour in MARCON 2.1B. These differences are mainly due to the MELCOR models for candling during melting, in-core axial conduction, and continued oxidation and heat transfer from core debris following lower head dryout. Three sensitivity calculations have been performed with MELCOR to address uncertainties regarding modeling of the core-concrete interactions. The timing of events and the gas and radionuclide release rates are somewhat different in the base case and the three sensitivity cases, but the final conditions and total releases are similar.

11410 **A methodology for analyzing the detection and suppression of fires in nuclear power plants.** Siu, N.; Apostolakis, G. (Univ. of California, School of Engineering and Applied Science, Los Angeles, CA). *Nuclear Science and Engineering;* **94**: No. 3, 213-226(Nov 1986).

The assessment of the fire risk in nuclear power plants requires the analysis of fire scenarios within specified rooms. A methodology that integrates the fire protection features of a given room into an existing fire risk analysis framework is developed. An important component of this methodology is a model for the time required to detect and suppress a fire in a given room, called the "hazard time." This model accounts for the reliability of fire detection and suppression equipment, as well as for the characteristics rates of the detection and suppression processes. Because the available evidence for fire detection and suppression in nuclear power plants is sparse and often qualitative, a second component of this methodology is a set of methods needed to employ imprecise information in a statistical analysis. These methods can be applied to a wide variety of problems.

11411 **Controlling principles for prior probability assignments in nuclear risk assessment.** Cook, I.; Unwin, S.D. (United Kingdom Atomic Energy Authority (UKAEA) Culham Lab., Abingdon). *Nuclear Science and Engineering;* **94**: No. 2, 107-119(Oct 1986).

As performed conventionally, nuclear probabilistic risk assessment (PRA) may be criticized as utilizing inscrutable and unjustifiably "precise" quantitative informed judgment or extrapolation from that judgment. To meet this criticism, controlling principles that govern the formulation of probability densities are proposed, given only the informed input that would be required for a simple bounding analysis. These principles are founded upon information theoretic ideas of maximum uncertainty and cover both cases in which there exists a stochastic model of the phenomenon of interest and cases in which these is no such model. In part, the principles are conventional, and such an approach is justified by appealing to certain analogies in accounting practice and judicial decision making. Examples are given. Appropriate employment of these principles is expected to facilitate substantial progress toward PRA scrutability and transparency.

11412 **Energy partition of a core melt accident in a nuclear power reactor.** Amarasooriya, W.H. Lafayette, IN; Purdue Univ. (1986). 375p. University Microfilms Order No. 86-22,113.

Thesis (Ph. D.).

A broadband data base was established on the energetics of single phase and two-phase discharge into a liquid pool. The experimental setup using simulant fluids was a 1/7 scale model of the core-and-vessel configuration of loop-type liquid metal fast breeder reactor. The condensation-driven entrainment of the pool liquid into the expanding bubble was significant. The impact pressure on the top of the containment vessel dropped significantly because of heat transfer caused by the mixing of gas and liquid resulting from the Taylor instabilities formed at the pool-cover gas interface. The discharge of the steam water mixture into the Freon-11 pool was energetic and resulted in high impact pressures. A parametric analysis was conducted for the thermal to mechanical energy conversion of a steam explosion accident in a pressurized water reactor. This study provides the groundwork for energy partition by providing the ideal explosion energy for a broad range of initial conditions. The structural analysis of the lower plenum of the reactor pressure vessel was conducted with the finite element computer code STRAW (A Nonlinear Fluid-Structural and Thermomechanical Finite Element Program), which was coupled with fluid modeling in order to account for the rapid pressure drop during expansion.

11413 Fission-product release from UO/sub 2/ under LWR-accident conditions: Recent data compared with review values. Osborne, M.F.; Collins, J.L.; Lorenz, R.A. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 191 of Fission product behavior in ceramic oxide fuel. Hastings, I.J. Columbus, OH; American Ceramic Society (1986). (CONF-850536—). Contract AC05-84OR21400.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

Studies of fission-product release from commercial LWR fuel at temperatures up to 200°C in steam have shown that >50% of the Kr, I, and Cs may be released within 20 min. These data are in fairly good agreement with the results of a previous NRC review, but the influences of specific test/accident conditions other than temperature (which is the most important variable) on the behavior of these and other fission products are apparent. In particular, chemical effects related to the extent of cladding oxidation may dominate, as in the case of tellurium.

11414 Grain-boundary sweeping and liquefaction-induced fission-product behavior in nuclear fuel under severe-core-damage accident conditions. Rest, J. (Materials Science and Technology Div., Argonne National Lab., 9700 S. Cass Ave., Argonne, IL 60439). pp 223-248 of Fission product behavior in ceramic oxide fuel. Hastings, I.J. Columbus, OH; American Ceramic Society (1986). (CONF-850536—).

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

The theoretical FASTGRASS-VFP model has been used in the interpretation of fission-gas, iodine, tellurium, and cesium release from (1) irradiated high-burnup LWR fuel in a flowing steam atmosphere during high-temperature, in-cell heating tests performed at Oak Ridge National Laboratory and (2) trace-irradiated and high-burnup LWR fuel during severe-fuel-damage (SFD) tests performed in the PBF reactor in Idaho.

25 ENERGY STORAGE

11415 (EPRI-AP—4875) Dynamic operating benefits of energy storage: Final report. Fancher, R.B.; Jabbour, S.J.; Spelman, J.R. (Decision Focus, Inc., Los Altos, CA (USA)). Oct 1986. 56p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920098.

The use of energy storage power plants to enhance power system operational flexibility (spinning reserve, load following, reduced minimum loading of power plants, etc.) yields substantive economic benefits due to reduced fuel use, lower operating and maintenance costs, and extended life of power plants. Inclusion of these benefits in generation expansion studies could increase the economic incentives of installing storage and fuel cell power plants. The objective of this project is to identify the benefits of energy storage due to the enhanced system operational flexibility, or simply called dynamic operating benefits (DOB). The results of an international symposium on DOB and three case studies in the US are reported. The results produce strong evidence of the reality and significance of dynamic operating benefits of energy storage and the importance of including that benefit in generation expansion studies.

2506 Thermal

REFER ALSO TO CITATION(S) 11545

11416 (BFR-R—15-1986) Application of latent heat stores. Johnsson, H.; Kellner, J.; Malmstroem, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 42p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750622.

This project has brought together and analysed data and results from various systems for heating and cooling in which salts have been used as latent heat storing media. There are today a number of commercially available salts for latent heat storage of heat and/or cold for operation over the range -30 degree C to +95 degree C. In principle, latent heat stores can be used for all types of heat storage within this temperature range. In cost terms, however, latent heat stores are generally not capable of competing with conventional heat stores such as hot water storage tanks. However, in applications where system design considerations require that the difference in temperature between the maximum and minimum storage must be low latent heat stores are competitive. An important conclusion in the report is that storage of cold in latent heat stores often exhibits very good cost performance. However, few installations of this type are in use. The review of latent heat stores indicates that there should be many potential applications in which latent heat storage should be economically viable.

11417 (DOE/CE/26520—T1) Aquifer thermal energy storage district cooling in downtown St. Paul: Feasibility study. Spurr, M. (District Heating Development Co., St. Paul, MN (USA)). Nov 1986. Contract FG01-85CE26520. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003445.

Is it feasible to store winter-chilled groundwater in an aquifer for summer air conditioning via a district cooling system. This study examined building loads, hydrogeologic factors, cooling system design, distribution alternatives, legal factors and economic feasibility. Groundwater would be pumped to the surface, cooled to 2.5°C using ambient water air, and injected into a second well for storage. The original concept provided for chilling water in a district cooling loop by transferring "chill" from the stored water using a heat exchanger. The groundwater, after absorbing heat from the district cooling loop, would then be reinjected into the first well. A survey of chilling equipment in 36 buildings was conducted, and the costs of conversions to district cooling were estimated. A 200 foot deep, widely used sandstone/limestone aquifer was selected due to low cost per unit pumping capacity. Due to the constraints posed by economic competition with the status quo, the conceptual design was substantially modified: reject water from a large existing heat pump system was the presumed water source for winter cooling; and after summer retrieval and air conditioning use, water would be pumped to the storm sewer rather than reinjected.

11418 (DTH-LET-RE—86-6) Economics, technology, and systems integration of aquifer thermal-energy storage. Qvale, B.; Leth, J.A.; Hagelskjaer, J.; Boldt, J.; Andersen, L.J.; Schleisner, L.; Olsen, H.; Mortensen, J. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik; Risoe National Lab., Roskilde (Denmark); Danmarks Geologiske Undersoegelske, Copenhagen). Sep 1986. 72p. Danmarks Tekniske Hoejskole, Lab. for Energiteknik, Bygning 403, DK-2800 Lyngby, Denmark.

The use of aquifers to improve the performance of heating systems is being discussed. The source of heat of these systems, that may or may not incorporate heat pumps, is solar energy (groundwater heat pumps), cogeneration heat, industrial waste heat, heat from garbage incineration, and geothermal heat. The report discusses the similarities and differences between these various applications. The work that has to be undertaken before, during and after the establishment of an aquifer thermal-energy storage unit is presented, together with a subjective evaluation of where we stand today and what is needed for tomorrow. This forms the background for the central part of teh paper, namely a description of the Danish Aquifer Thermal Energy Storage Pilot Project. EM-2, EFP-80, EFP-81, EFP-82, EFP-84, EFP-85. 14 refs.

11419 Lessons learned from a membrane stratified thermal storage system. Reid, R.L.; Bedinger, A.F.G.; Wix, S.D. (Mechanical & Industrial Engineering Dept., Univ. of Texas at El Paso, El Paso, TX 79968-0521). pp 784-790 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The performance of a 64,400 gallon membrane stratified thermal storage system (TES) for the Oliver Springs Elementary School in Roane County, Tennessee was evaluated. The system was instrumented and monitored over a two year period. Efficiencies in the order of 40-80% were measured for the storage tanks so that the concept of membrane stratified thermal energy storage ap-

pears to be valid. However, during the two year period of this study, the TES system rarely operated for more than a day or two without human interaction. Indeed, the entire HVAC/TES system was plagued with operational problems. Thus, as presently installed, the TES system will not operate automatically for long periods of time without human interaction. For a building of this size and use patterns, the economic justification for such system is not obvious.

2509 Batteries

11420 (EPRI-AP—4948) Reliability, availability, and maintainability assessment of a Zinc Chloride Battery System: Final report. Himpler, H.P.; Erickson, E.J. (Arinc Research Corp., Annapolis, MD (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 160p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920144.

UNIRAM analyses guided the design of an advanced energy storage system for load leveling and management. The study showed that, in comparison with competing technologies that are available approximately 90% of the time, a 2-MW system of zinc chloride batteries would have an availability greater than 98%.

11421 (NP—7750608) Chemical and electrochemical energy research and development. Publications 1980.01.01-1985.09.30. (Risoe National Lab., Roskilde (Denmark)). Oct 1985. 23p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87750608.

The present list of publications comprises scientific, technical and popular articles, reports and lectures by members and associates of the departmental section: 'Chemical and Electro Chemical Energy Research and Development'. Only those works directly related to the professional activities of the section are included. The list is divided into; 0xx papers, 2xx reports and 3xx lectures. Entries are ordered alphabetically by author (where external authors have contributed the listing appears under first mentioned author from the C and EE-sect.

11422 Mechanism of the electrocatalytic reduction of oxygen in a tubular solid oxide electrolyte flow reactor. Nguyen, B.C.; Rincon-Rubio, L.M.; Mason, D.M. (Dept. of Chemical Engineering, Stanford Univ., Stanford, CA 94305). *Journal of the Electrochemical Society;* **133**: No. 9, 1860-1868(Sep 1986).

The nature of the electrode polarization process involving O/sub 2/ gas mixtures has been investigated in a 10 mole percent Y/sub 2/O/sub 3/-stabilized ZrO/sub 2/ tubular solid electrolyte cell with porous Au electrodes in the temperature range 650°-850°C. The polarization phenomena are dominated by cathodic processes occurring on the inside wall of the tube. In the intermediate oxygen pressure range (P/sub 0/2=10/sup -2/-0.21 atm), the reactor operated in a differential mode. The shapes of the experimental current-overpotential curves are in accordance with the form of a modified Butler-Volmer relationship with the forward and backward cathodic transfer coefficients being equal to 1 and with a model being employed in which charge transfer takes place in the two-phase region between the Au-electrode and ZrO/sub 2/ electrolyte. The most plausible rate-determining step is found to be the surface diffusion of adsorbed O/sub 2/ species on the electrolyte surface inside this two-dimensional ZrO/sub 2/-Au interface. The apparent exchange current I/sub o/app is found experimentally to be proportional to P/sub O/2 to the 0.53 +. 0.06 power. This behavior of I/sub 0/app eliminates many possible mechanisms and corroborates the one involving surface diffusion of O/sub 2/ in addition to charge transfer steps involving species O/sub 2//sup -/ and/or O/sup -/. For very low values of P/sub 0/2(<10/sup -3/ atm), the reactor operated in an integral mode with large conversions. In this case, significant changes that occur in the oxygen concentration owing to axial gas-phase diffusion must be accounted for in employing the above model. In the case of high pressures, both the processes of charge transfer and surface diffusion play a rate-determining role in the overall electrode dynamics. The activation enthalpy for the overall cathodic reaction is estimated to be 64 +. 8 kcal/mol.

11423 Experimental investigation of a porous carbon electrode for the removal of mercury from contaminated brine. Matlosz, M.; Newman, J. (Materials and Molecular Research Div., Lawrence Berkely Lab., Univ. of California, Berkeley, CA 94720). *Journal of the Electrochemical Society;* **133**: No. 9, 1850-1859(Sep 1986).

A flow[through porous electrode, made of reticulated vitreous carbon (RVC), has been designed to remove mercury from contaminated brine solutions. Experiments with a bench-scale reactor show that the mercury concentration of contaminated brine solutions can be reduced by as much as a factor of five thousand during a single pass through the electrode. The process is mass-transfer limited, and the results of the experiments are used to develop a general correlation for the dependence of the mass-transfer coefficient on the flow rate of electrolyte through RVC. In addition, the effect of counterelectrode placement on the cell resistance is examined, and the experimental data are compared to predictions from a mathematical model of the system. The model agrees favorably with the experimental results, and the benefits of upstream counterelectrode placement, indicated by the model, are verified.

29 ENERGY PLANNING AND POLICY

11424 (KTM/E-D—102) Market prospects of building automation systems, preliminary study. Sulku, J. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 28p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750651.

Decrease in energy consultion of buildings can be achieved either by structural means e.g. extra insulation or by improved control and maintenance. In the latter case building automation supervision and control systems is of great importance. Supplier review gave indication that at present buildings without mechanical ventilation are installed with simple control, equipment and mechanically ventilated or air conditioned are installed with control and on/off time-control. Present volume at building automation market is appr. 180 million Fmk. Advanced systems (optimizers, computer control) are estimated to exist appriximately in 15% of non-residential building volume, in 5% of industrial building volume and in 4% of multi-dwelling building volume. These represent appr. 5% of total building volume. The main difficulties to gain the potential savings are that there is great variety in motivation and knowledge between user organisations which result in unwillingness or lack of knowledge towards energy saving with building automation systems and that the present systems are not actively used due to lack of technical supervision, as systems at present are not very user oriented. At the moment no great improvement is expected thus also the gain of the theoretical saving potential will remain low.

11425 (KTM/E-D—104) Quality of indoor air and demand of ventilation in buildings. Seppaenen, O.; Majanen, A.; Palonen, A.; Sammaljaervi, E.; Kukkonen, E. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 280p. (In Finnish). NTIS (US Sales Only), PC A13/MF A01. File Number DE87750653.

The report summarizes the results of the indoor air project financed by the Ministry of Trade and Industry, Academy of Finland and the Fund of Occupational Health in the Ministry of Finance. The project lasted four years. It was co-ordinated by Laboratory of Heating Ventilation and Air Conditioning in Helsinki University of Technology. Twelve research units from various areas of science participated the project. The goal of the project was to find out the most important physical and chemical factor of indoor air climate, criteria for ventilation rates and the effect of indoor air quality on human wellfare and comfort. The report describes the most important important indoor air pollutants and other indoor air factors based on the research done abroad and in Finland. The health effects, sources, and control of each pollutant are handled in the beginning. After that other factors which has an effect on indoor air quality is handled, particularly the operation of heating ventilation and air conditioning systems, problem buildings, building materials and measurements.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 10836, 11457, 11458, 11465, 11466, 11478, 11572

11426 (EUR—9700) French HERMES model. The energy factor. Faubry, E.; Vidal, O de la Blache; Moncoble, J.E.; Zagame, P. (Commission of the European Communities, Luxembourg). 1985. 244p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

The macrosectoral european model HERMES was developed with a view of taking into account energy in the most detailed manner. Energy is represented therein as production factor as well as a sector of production. Energy is also defined explicitely in private consumption. This report describes first the interface between energy and economy as represented in the HERMES model. After the description of the working of the energy sub-model, the results by sector and energy products are given.

11427 (EUR—9771) HERMES: results of the interfuel substitution model in Greece. Samouilidis, J.E.; Vlachou, A.S.; Mentjas, G.N. (Commission of the European Communities, Luxembourg). 1985. 51p. European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

This paper is the final report for the energy part of the HERMES project. Interfuel substitution in the Greek economy is studied using an econometric model, which utilizes the translog cost function. Four major sectors of the Greek economy are examined: Transport, Agriculture, Fuel and Power products, and Industry (disaggregated into three branches). Fuel types are aggregated into four categories: solid fuels, petroleum products, crude oil, and electricity. The model is estimated using time-series data over the period 1960-1980. We present the results in the form of elasticities of substitution and price elasticities of demand. Final conclusions, concerning energy policy implications, are drawn upon the patterns of substitutability among the four fuel types.

11428 (NP—7900343) 1984-85 energy report, North Carolina Energy Policy Council. (North Carolina Dept. of Commerce, Raleigh (USA). Energy Div.). Dec 1986. 35p. North Carolina Dept. of Commerce., 430 N. Salisbury St., Raleigh, NC 27611. File Number TI87900343.

The near-term energy outlook for both the United States and North Carolina is positive: adequate supplies of energy combined with moderation in energy prices. Near-term natural gas markets are likely to mirror the oil market: supplies should be abundant and prices should ease in sympathy with oil prices. Coal markets have always been highly competitive and now, with increased pressure from more abundant oil and gas supplies, coal prices are also likely to grow at less than the general rate of inflation for several years. The outlook for electricity should continue to be favorable, particularly in North Carolina. Generation capacity is ample, and price growth should be moderate, as a result of modest growth in fossil fuel prices. The principal risk to the current favorable outlook for energy is the risk of complacency. OPEC, while temporarily under pressure, still holds a position of overwhelming dominance in terms of low cost oil reserves. In contrast, oil production for the US, the UK, and the Soviet Union will begin an inevitable decline within the next few years. World production and economic growth will continue and oil demands will begin a slow but steady recovery. OPEC production will be the principal source available to meet this growing demand. As world oil consumers turn back to OPEC, the pricing power of OPEC will gradually recover. Once again, the world is likely to become dependent on a politically unstable region for a commodity which is vital to economic growth. North Carolia should continue to puruse policies which encourage efficient use of energy, and which consider the potential risks of a return to over-dependence on foreign oil. The state is particularly well positioned with respect to energy, a fact that should be promoted as a comparative advantage when seeking to attract new business enterprices.

11429 (REPT—5-49) Multiple objective modeling: experimental results with interactive methods in the Netherlands. Kok, M. (Technische Hogeschool Delft (Netherlands)). 1985. 34p. (ETN—86-98479). NTIS, PC A03/MF A01.

An energy supply model which handles economic, environmental, and strategic factors was developed. Results of the model, using an interactive multiobjective linear programming method and preference information of representatives (actors) of organizations and institutes involved in energy policy problem are presented. Several methods and objective functions were used to obtain insight into the fuzziness of the preferences and to investigate empirically the differences between the interactive methods. The behavior of the actors during the interactive process and their treatment of uncertainties is mentioned.

11430 (RISO-M—2606) Technical-economic model for the industrial energy consumption in Denmark. (Risoe National Lab., Roskilde (Denmark)). Jul 1986. 151p. (In Danish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87750598.

This report presents a model for the industrial energy consumption in Denmark. In short the model may be characterized as an econometric sub-model that converts forecasts for the energy price and the economic development to forecasts for the industrial energy consumption. The industry is divided into 14 branches and four types of fuels. In constructing the model the development over the period 1966 to 1980 is analysed at a fairly disaggregated level of branches and the model is estimated on annual data for this period. To explain the development of the energy consumption both ecomonic and technical factors are considered. The most important economic factors have been changes in the level of production, changes in the real energy price, in employment and investments. Important technical changes have been the introduction of new production techniques and the starting-up and closing-down of specific productions.

11431 (THD-WI—85-49) Multiple objective energy modeling: experimental results with interactive methods in The Netherlands. Kok, M. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1985. 30p. Delft Univ. of Technology, Dept. of Mathematics and Informatics, P.O. Box 356, 2600 AJ Delft, Netherlands.

Energy planning in The Netherlands is a problem with highly conflicting objectives. In addition to the traditional economic objective (minimization of investment and operational costs), environmental (e.g. minimization of the acid rain pollutants and nuclear waste) and strategic (e.g. minimization of the indigenous natural gas supply) objectives are now considered to be of interest. A description is presented of the conflicts in this problem, and of the energy supply model which was developed by the Energy Study Centre (Petten) in order to analyze it. Next, results of the model are presented, using an interactive multi-objective linear programming method and preference information of representatives (actors) of several organizations and institutes who are involved in the energy policy problem. Several methods and objective functions were used to obtain insight in the fuzziness of the preferences and to investigate empirically the differences between the interactive methods. Finally, the behavior of the actors during the interactive process and their treatment of uncertainties are discussed.

11432 (VTT-TIED—580) Expert systems in energy systems. Keronen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 144p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750648.

In Finland the branch of knowledge base systems is quite new and a breakthrough was reached in the autumn 1984, when the Technology Development Centre (TEKES) and the Technical Research Centre of Finland (VTT) decided to start research work in the area. The main interest of this project is to find out how and where knowledge based systems can be used in energy systems. First in the research work was a familiarization period when the basic structures, features and some applications of expert systems was studied. After this first step two demos w built with a PC-microcomputer and SAGE-called expert system shell. The demos both include about 100 rules and the subjects are the fault diagnosis

of a district heating system and the choice of heat reservoir. After the familiarization period there was an identification of possible applications and a filtration of the most promising ideas. All this work was done by experts in different areas of energy systems, giving especially high priority to the practical aspects. The project showed that there are several promising areas in energy technology where expert systems can be used. For example in the fault diagnosis, energy management and different kinds of maintenance operations can knowledge based systems help the operators in district heating and power systems. It is obvious that expert systems have a great potential also in education and training of personnel but these kinds of subjects are left outside the project.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 11440, 11447, 11448, 11457, 11459, 11467, 12965

11433 (DOE/EIA—0497) Analysis of seasonality in energy prices. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Aug 1986. 72p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. File Number DE87004099.

The identification of normal seasonal trends in energy prices is of considerable importance to budget planners and households. The purpose of this paper is to examine several key energy price series for the existence of these seasonal patterns, and to determine whether these patterns have changed over time. The prices examined are motor gasoline, heating oil, retail residual fuel oil, and residential electricity. The principal users of this analysis are energy analysts and budget planners in private industry and government.

11434 (DOE/ER—0300) Science and engineering manpower in energy: labor market and education issues and outlook: Proceedings. Blair, L.M.; Smalley, L.B. (eds.). (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1986. Contract AC05-76OR00033. 167p. (CONF-860537—). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002081.

From Symposium on science and engineering manpower in energy: labor market and education issues and outlook; Washington, DC, USA (14 May 1986).

Individual presentations are entered separately into the data bases. (PSB)

11435 (IVEM—8) To an efficient and durable energy supply in the northern part of The Netherlands. (Rijksuniversiteit Groningen (Netherlands)). May 1985. 135p. (In Dutch). Interfakultaire Vakgroep Energie en Milieukunde Rijksuniversiteit, P.O. Box 72, 9700 AB Groningen, Netherlands.

An analysis is given of the future possibilities for energy conservation and decentralization of power generation in the three northern provinces of The Netherlands (Friesland, Groningen and Drenthe). Possible investments, consequences for air pollution and changes in employment are elaborated.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 11461, 11462, 12241, 12244, 12247, 12280, 12294, 12300, 12313, 12380, 12402

11436 (AD-A—172544/9/XAB) Research and development of hazardous/toxic waste analytical screening procedures. Available field methods for rapid screening of hazardous-waste materials at waste sites. Final report, December 1981-December 1982. Snyder, R.E.; Schulte, B.E.; Mangoba; McHale, E.T. (Atlantic Research Corp., Alexandria, VA (USA)). Jun 1983. 68p. (—42-5753-I). NTIS, PC A04/MF A01.

The objective of this study was to perform preliminary laboratory evaluation of as many of the selected Class A poison detection techniques as possible within the time constraints of the program. Each of these methods was tested, when possible, for their limits of detection, reproducibility of test results, accuracy, maximum sample volume necessary, and cross sensitivities to other Class A poisons. The methods to be evaluated were for arsine, hydrogen cyanide, cyanogen chloride, nitric oxide, nitrogen dioxide, lewisite, phosgene, mustard gas, and phosphine.

11437 (AD-A—173479/7/XAB) Field test of life-cycle cost analysis method for solvent management. Special report. Donahue, B.A.; Sarver, D.W.; Bellino, E.M. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Sep 1986. 21p. (CERL-SR-N—86/21). NTIS, PC A02/MF A01.

This report documents the field test of the U.S. Army Construction Engineering Research Laboratory's (USA-CERL) procedure for calculating the life-cycle cost (LCC) of solvent recycling. The test was conducted at the Rock Island Arsenal, which currently recycles its solvents off-post. The USA-CERL LCC analysis method was used to compare the off-post method with solvent recycling by distillation on-post. The LCC format was found to be useful in comparing the two methods and showed that the on-post method would provide the arsenal with significant savings over a 10-year project life.

11438 (TVA/OP/PMO—87/1) The Tennessee State Acid Rain (STAR) Project. Bain, W.S. (Tennessee Valley Authority, Chattanooga (USA). Office of Power). 1986. 20p. (CONF-861132—1). NTIS, PC A02/MF A01. File Number DE87900341.

From 10. symposium on flue gas desulfurization; Atlanta, GA, USA (18 Nov 1986).

As a part of the State Acid Rain (STAR) program administered by the Environmental Protection Agency (EPA), the State of Tennessee proposed that the Tennessee Valley Authority (TVA) be used as a model to determine the effects of implementing acid rain controls on a large multi-State utility. Four possible strategies for implementing SO_2 reductions on the TVA system were analyzed: a cap on emissions for the TVA system as a whole, State-wide emissions caps on TVA plants in each of the three States where TVA plants are located, individual plantwide caps, and a plant emission-rate strategy. National reduction goals of 5, 10, and 12 million tons of SO_2 (1 ton = 0.907 metric ton) from utilities only were analyzed for high and low load electrical growth projections in the TVA region. Estimates were made of additional plant capital investments, annual operating costs, and percent increase in total revenue requirements for each case.

11439 Overview of the remedial action priority system (RAPS). Whelan, G.; Droppo, J.G.; Steelman, B.L.; Strenge, D.L. (Pacific Northwest Laboratory, Richland, WA). pp 191-227 of Pollutants in a multimedia environment. Cohen, Y. New York, NY; Plenum Press (1986). (CONF-860156—).

From 1. workshop on pollutant transport and accumulation in a multimedia environment; Los Angeles, CA, USA (22 Jan 1986).

This paper describes the physics-based risk assessment methodology called the Remedial Action Priority System (RAPS). This methodology uses empirically, analytically, and semianalytically based mathematical algorithms and a pathways analysis to predict the potential for contaminant transport from a hazardous waste disposal site to local populations. Four major pathways for contaminant migration are considered in the RAPS methodology; groundwater; overland; surface water, and atmospheric. Using the predications of contaminant transport, simplified exposure assessments are performed for important receptors.

2904 Natural Resources

REFER ALSO TO CITATION(S) 11442, 12315, 12317

11440 Regional environmental simulation of African cattle herding societies. Krummel, J.R.; Markin, J.B.; O'Neill, R.V. (Oak Ridge National Lab, Oak Ridge, TN). *Human Ecology;* **14**: No. 1, 117-130(Mar 1986).

Regional analyses of the interaction between human populations and natural resources must integrate landscape scale environ-

mental problems. An approach that considers human culture, environmental processes, and resource needs offers an appropriate methodology. With this methodology, we analyze problems of food availability in African cattle-keeping societies. The analysis interrelates cattle biomass, forage availability, milk and blood production, crop yields, gathering, food subsidies, population, and variable precipitation. While an excess of cattle leads to overgrazing, cattle also serve as valuable food storage mechanisms during low rainfall periods. Food subsidies support higher population levels but do not alter drought-induced population fluctuations. Variable precipitation patterns require solutions that stabilize year-to-year food production and also address problems of overpopulation.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 10793, 10797, 10818, 11449

11441 (LA—10760-MS) Publications of Los Alamos research, 1985. Sheridan, C.J.; McClary, W.J.; Rich, J.A.; Dussart, S.A. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 181p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87003575.

This bibliography is a compilation of unclassified publications of work done at the Los Alamos National Laboratory for 1985, including laboratory reports, papers released as non-laboratory reports, journal articles, books, conference papers, papers published in congrssional hearings, theses, and US patents. (LEW)

11442 (NP—7900351) [Department of Industry, Technology and Resources]: Annual report for the year ended June 30, 1986. (Department of Industry, Technology and Resources, Victoria (Australia)). 30 Jun 1986. 137p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87900351.

This report presents a summary of the activities of the Victoria's Department of Industry, Technology and Resources for the year ending June 30, 1986. The Department includes the former departments of industry, commerce, technology, minerals, and energy. (DLC)

11443 (STEV—1986-R7) IEA Peat production and utilization project. Annual report, 1985. (Statens Energiverk, Stockholm (Sweden)). 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87750615.

The object is to obtain, assess and treat pertinent information, to accomplish state-of-the-art studies and to work out plans for future co-operative research, development and demonstration work in the field of peat production and utilization. The area is divided into five parts. For each part a state-of-the-art study is performed, the parts are: Milled peat and sod peat, Fundamentals in peat-dewatering, Peat de-watering techniques, Peat classification and standards, Information exchange.

11444 S. 2642: a bill to authorize appropriations for the Department of Energy for national security programs for fiscal year 1987, and for other purposes. Introduced in the Senate of the United States, Ninety-Ninth Congress, Second Session, July 15, 1986. Washington, DC; Government Printing Office (1986). 22p.

The National Security Programs Authorization Act for Fiscal Year 1987 authorizes appropriations for DOE programs which include weapons activities, materials production, defense waste and byproducts managements, verification and control technology, nuclear safeguards and security, security investigations, and naval reactors development. The total $7.425 billion funding covers plant and capital equipment at designated locations and projects. Undistributed reductions in national security programs amount to $300 million, with limitation placed on the Strategic Defense Initiative program. Title II addresses recurring general provisions and miscellaneous provisions relating to the transfer and availability of funds.

11445 Department of Energy Civilian Energy Programs Authorization Act for fiscal year 1987. Introduced in the House of Representatives, Ninety-Ninth Congress, Second Session, July 28, 1986. Washington, DC; Government Printing Office (1986). 88p.

Part 1 of the House Science and Technology Committee's report on H.R. 4926 recommends passage of the bill with certain amendments, many of which raise the level of appropriations for state line items and reduce those of others. Changes include increases in civilian nuclear fission, conservation, solar, and fusion programs; decreases in geothermal, nuclear waste, uranium enrichment, and administrative programs. The amended budget is $169.3 million less than the DOE request of $2736 billion. The report lists those amendments, summarizes the legislative history and subcommittee hearings relating to the bill, and reviews committee actions. The amended bill reduces. Dissenting views of committee members conclude the report.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 10961, 11237, 11263

11446 (BNL—38826) Evolving an acceptable nuclear power fuel cycle. Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Oct 1986. Contract AC02-76CH00016. 15p. (CONF-860826—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003228.

From National meeting of the American Institute of Chemical Engineers; Boston, MA, USA (24 Aug 1986).

The following issues are examined: long-term safe nuclear power plant operation; acceptable nuclear waste management and, mainly, high-level waste management; and provision for long-term fissile fuel supply in a long-term nuclear fission economy. (LM)

11447 What has happened to arms control. Drell, S.D. (Stanford Linear Accelerator Center). pp 18-26 of Nuclear deterrence: New risks, new opportunities. Kelleher, C.M.; Kerr, F.J.; Quester, G.H. Elmsford, NY; Pergamon Press (1986).

"Star Wars" offers no path for achieving either of the two visions that have given it momentum - the vision to substitute a defensive strategy for deterrence, or the vision to create, or even improve, the environment for arms control and reductions. Most likely it will lead to a more dangerous world, stimulating an arms race, as competition of countermeasures and confrontation, leaving the ABM treaty in its wake as a monument to past hopes. The ABM treaty presently has a central and almost unique bearing on US-Soviet relations and on the prospect for cooperative pursuit of peace and security. What is done actively to enhance its constructive influence, or contrarily to undercut it deliberately or inadvertently, can have major impact on the nations' security and the risk of nuclear war. Therefore, priority should be given to maintaining the effectiveness of the ABM Treaty. Both the Soviet Union and the United States should take care not to undermine, deliberately or inadvertently, this cornerstone of efforts to avoid unremitting confrontation. The path to a safer world must be paved initially - and indeed for a large part of the way - by progress in arms control leading to a drastic reduction of armaments and to preventing the deployment of weapons in space. Protecting society in the event of nuclear exchange by any means other than preventing nuclear war remains an illusion, in view of the uncompromising reality of the number and power of nuclear explosives, and the diversity and substantial survivability of delivery means.

11448 Atoms for peace. An analysis after thirty years. Pilat, J.F.; Pendley, R.E.; Ebinger, C.K. Boulder, CO; Westview Press, Inc. (1985). 299p. Westview Press, Inc., 5500 Central Avenue, Boulder, CO 80301.

Thirty years ago, President Eisenhower's Atoms for Peace proposal to the U.N. provided the basis for development of nuclear cooperation, trade, and nonproliferation policy in the noncommunist world. Ever since its inception, however, the policy has sparked widespread debate, and it remains controversial today. Exploring the past, present, and future significance of Atoms for

Peace, the contributors to this volume analyze the future role of the U.S. in international affairs, the nature of controls over nuclear cooperation and trade, the scope and limitations of international cooperation in nuclear energy and nonproliferation matters, and the prospects for multinational and international institutional measures to achieve these ends.

11449 **Nuclear data for basic and applied science. Volume 1.** Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). 1730p. (CONF-850507—). Gordon and Breach, 50 West 23rd Street, New York, NY 10010.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

This book presents the papers given at a conference on nuclear data for basic and applied science. Topics considered included: nuclear data needs for fusion reactors; fast-neutron interaction with niobium; neutronic analysis of fusion-fusion (hybrid) blankets; measurements of 14 MeV neutron activation cross sections; recent experimental data on sub-barrier fission of light actinides; and intermediate structure in the fission cross sections of the even curium isotopes.

2910 Conservation

REFER ALSO TO CITATION(S) 11547, 11557, 11558

11450 **(EUR—9287-DE) Energy audit No. 4: The glass industry of the European Communities.** (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1984. 203p. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energie.

The energy consumption of glass production processes is counter-balanced by the considerable energy conserving effect achieved by the use of glass products, namely insulating glass, insulating fibers, foam glass and glass bricks. The transportation sector's contribution to energy conservation consists in the use of weight-saving vehicle glazing and glass-fiber reinforced plastics. Moreover, the melting of recycled glass has a considerable share in energy conservation. Due to innovative developments special flat glass may be used in solar power plants. The report recommends a number of measures required for further energy conservation in the glass industry and the use of glass products.

11451 **(EUR—10199-EN) Employment effects of energy conservation investments in EC countries.** Hohmeyer, O.; Jochem, E.; Garnreiter, F.; Mannsbart, W. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 107p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The purpose of this study was to analyse the impact of additional activities in energy conservation on production, employment, income and imports in four EC Countries, which could be induced by an enforced energy demand policy. The economic analysis carried out required extensive empirical work on each technology included in each country studied. Thus, the analysis was restricted to a selection of four countries: Denmark, France, United Kingdom and Federal Republic of Germany, accounting for more than 70% of the EC's primary energy consumption. In these countries only six technologies could be studied in depth. The following six technologies were chosen to give a rough representation of the technical potential which may be tapped by an enforced energy demand policy: district heating (in most cases under combined heat and power generation), insulation of residential buildings, heat exchangers for heat recovery, large gas engine driven heat pumps, domestic solar hot-water systems and biogas plants in agriculture. With 50 tabs., 13 figs.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 10863, 10884, 10885, 10886, 11426, 11427, 11432, 11572

11452 **(DOE/CH/10286—1) New energy technologies for Illinois and the Midwest: Proceedings.** (Illinois Univ., Chicago (USA). Energy Resources Center). 28 Oct 1985. 157p. (CONF-8510324—). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002270.

From 13. annual Illinois energy conference; Chicago, IL, USA (28 Oct 1985).

Separate entries have been processed for individual conference papers. (PSB)

11453 **(NP—7750635) Energy system of Norway in the year 2000. An analysis of possibilities, economy and environmental consequences.** Borring, J.; Fuglestvedt, J.; Haug, H.; Hjelle, D.; Kristiansen, A. (Oslo Univ. (Norway). Raadet for Natur- og Miljoefag). Feb 1986. 234p. (In Norwegian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87750635.

In a Report to the Storting (Parliament) on "Norway's future energy use and production" of March 1985, the Government defines the main lines of Norway's energy policies towards the year 2000. In the present report, alternative ways of meeting the energy demand in 2000 are analyzed with respect to economy and environmental consequences, by Raadet for natur og miljoefag ("The council for environmental subjects") of Oslo University. The basis of the analysis is the prognoses of the energy demand in the Government's report. Taking into account the energy loss in burning oil and solid fuel, the energy consumption in 2000 is estimated to 140 TWh (oil for transport purposes and coal/coke for non-energy purposes are not included in this estimate). In the proposed alternative plan, 90% of the total energy demand is met in the same way as in the Government's plan, that is to say by hydroelectric power (102 TWh), solid fuel (10 TWh) and oil (14 TWh). To meet the last 10% of the demand the alternative plan introdues energy conservation measures (7 TWh), solar energy (1 TWh), heat pumps (4 TWh) and biomass (2 TWh). In this way the amount of new hydroelectric power can be reduced with 6 TWh and oil with 8 TWh, as compared to te Government's plan. As for the economic consequences, the analysis shows that the total cost of the alternative plan amounts to 85 billion NOK as compared to 90 billion NOK. Other scenarios, including gas power plants have also been studied, showing that the differences in cost between the various scenarios are small. A main conclusion of the analysis is that the energy demand in the year 2000 can be met in ways that cause fewer environmental problems without extra cost for the country.

11454 **(NZERDC—131) Energy use in transport: Data report.** (Beca, Carter, Hollings and Ferner Ltd., Auckland (New Zealand)). Jun 1986. 136p. NTIS (US Sales Only), MF A01. File Number DE87900433.

This document presents data on transport and energy use for 1984 calendar year with time trends. A large amount of research has been carried out since the original report which has filled gaps in the statistical data base. In some cases this indicates the need for revision of the original data tabulations. The approach successively disaggregated global data using published and unpublished official statistics, surveys and research reports. Data sources were compared to provide an internally consistent set of tabulations. Quality of data is not uniform, and, consequently, some parts of the analysis are more reliable than others. The report is laid out in summary form with supporting tables and appendices.

11455 **(STEV—1986-2) Combined heat and power production in local communities. Production, potential, prognoses.** (Statens Energiverk, Stockholm (Sweden)). Feb 1986. 201p. (In Swedish). NTIS (US Sales Only), PC A10/MF A01. File Number DE87750621.

The Swedish Government has commissioned the National Energy Administration to study the development of industrial backpressure and combined heat and power (CHP) production in district heating (DH). At present there are CHP plants ranging

from 7 MW to 250 MW of electricity in 19 municipalities. Most of the plants are municipally owned, while others are owned partly or entirely by power companies. District heating deliveries in 1984 in these municipalities totalled 18.7 TWh. It is estimated that in 1990 district heat production in these municipalities will amount to at least 22 TWh, 2.8 TWh of which is derived from combustion of waste, 5.0 TWh from heat pumps and 1.8 TWh from industrial waste heat. Summing up, it may be said that the possible CHP production around the year 1990 in the existing CHP plants in 19 municipalities is 3.6-6.2 TWh of electricity and the CHP potential in nine large municipalities without CHP plants 1.5-2 TWh of electricity. The economic possibilities for further expansion of combined heat and power are difficult to survey. The cost pattern with regard to investments may be defined with a reasonable degree of accuracy, but it is difficult to specify the future revenues from the production of electricity. The National Energy Administration will be investing SEK 15 million in research and development work concerning small combined heat and power plants during the period of 1984-1987. The Administration has recently awarded a grant to a prototype and demonstration facility for 4 MW of electricity and 12 MW of heat in one municipality.

11456 **(TVA/OP/CEM—87/11) Energy 86: Today's opportunities for partnerships.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Conservation and Energy Management). 1986. 43p. NTIS, PC A03/MF A01. File Number DE87900328.

Abstracts for each session are presented. (PSB)

11457 **Verification of energy's role as a determinant of U.S. economic activity, 1890-1985.** Santini, D.J. (Center for Transportation Research, Argonne National Lab., Argonne, IL 60439). pp 82-88 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper verifies, through statistical analysis of annual data from 1890-1985, the fact that increases in both energy price and energy consumption per unit of national output are uniquely important determinants of following-year aggregate declines in macroeconomic activity. Increases in energy price are treated as economic efficiency losses, while increases in the energy intensity of national output are termed thermodynamic efficiency losses. These losses are shown to be associated weakly with contemporaneous price inflation and with following-year declines in the rate of growth of the money supply. Combined increases in both energy price and consumption per unit output cause an increase in consumer spending on energy that is in excess of the rate of increase of national output (GNP). When a single energy spending increase variable is substituted for separate price and consuption variables, increases in this variable are shown to cause following-year declines in the rate of growth of the money stock for both M1 and the old M2 series. The energy spending variable is hown to explain more of following-year variation in GNP growth than does a charge in rate of growth of the M1 or old M2 money stock. When both money and energy variables are tested jointly as predictors of the following-year GNP variable, energy and M1 remain statistically significant and M2 retains its expected sign. A test of money variables as a cause of the energy spending variable does not support the hypothesis that money causes energy. The results indicate that energy is a more important determinant of macroeconomic activity than money, though supporting the theory that money is uniquely important.

11458 **Long-run forecasts of regional energy prices with the Argonne Regional Energy Price Simulator (AREPS).** South, D.W.; Hanson, D.A. (Argonne National Lab.). pp 574-591 of Proceedings of the Seventh Annual North American Meeting, International Association of Energy Economists. Thompson, W.F.; DeAngelo, D.J. Boulder, CO; Westview Press, Inc. (1985). (CONF-851285—).

From 7. annual North American meeting of the International Association of Energy Economists; Philadelphia, PA, USA (10 Dec 1985).

Since the early 1970s, energy prices have played an increasingly important role in determining future energy consumption patterns and levels of energy and economic activity. As a result, forecasts of energy prices are regularly required in the broad array of energy-related analyses conducted by public- and private-sector organizations. Unfortunately, there is often a need for energy price forecasts with different spatial or temporal details than those reported in published sources. For example, published projections of energy prices may have the required spatial, sectoral, and fuel-type dimensions, but only be a short-run (1-5 year) or intermediate-term (5-15 year) forecast, when a longer-run outlook is needed. Alternatively, an appropriate set of energy prices may have a long-run time horizon but only at the national level. This paper describes a means to resolve these two data problems.

11459 **An economic overview of our energy future.** Hitch, C.J. (Univ. of California, Lawrence Berkeley Lab., Berkeley, CA 94720). pp 18 of Energy: For ourselves and our posterity. Perrine, R.L.; Ernst, W.G. Old Tappan, NJ; Prentice Hall, Inc. (1985).

A reduction in the supply of energy or an increase in its real cost damages the economy and reduces our incomes below what they would otherwise be. There are ways in which one can mitigate this effect but not eliminate it. The amount of the loss can be manageable if there is time for the economy to adjust and if energy prices are permitted to reflect their new higher costs and scarcities - at least if the real costs no more than double from their 1979 levels: that is, to about $50 per barrel of oil equivalent in 1982 dollars. Large sudden interruptions in energy supply, on the other hand, can be disastrous. Fear of catastrophes from using coal or nuclear fuels, whether real or imaginary, could seriously hamper the process of adjustment to even gradual contractions of supply. Policy implications are clear. One should be willing to pay higher premiums for security of the energy supply. One should place great stress on cost-effective conservation. One should complete most electric generating plants planned or under construction, doing one's best to resolve fears of catastrophe associated with burning coal and nuclear fuels. One should develop those nuclear, synthetics-from-coal, oil-from-shale, and other technologies that promise to provide a long-run ceiling for primary energy costs at around $50 per barrel (1982 dollars). But all these efforts will fail if holding energy prices below their true costs is insisted on.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 10961, 11444, 11445, 11447, 11448, 11453, 11459, 11587

11460 **(CONF-8408211—Summ.) Energy and US industrial competitiveness in world markets.** Mintzes, J. (Aspen Inst. for Humanistic Studies, CO (USA)). 1984. Contract FG01-83PE70523. 49p. NTIS, PC A03. File Number DE87000740.

From Energy and U.S. industrial competitiveness in world markets conference; Aspen, CO, USA (8 Aug 1984).

This is an account of the meeting held in Aspen, Colorado, on August 8-12, 1984. The summary covers policy conclusions, proceedings, energy cost patterns and competitiveness of US energy-intensive industries, and competitive outlook in selected US energy-intensive and related industries. (DLC)

11461 **(ORNL/M—255) Environmental Compliance Program reference book: Endangered Species Act/Fish and Wildlife Coordination Act.** (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 248p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003943.

The Endangered Species Act and the Fish and Wildlife Coordination Act are major federal statutes to protect plant and animal resources from adverse effects due to development projects. Both Acts require consultation with wildlife authorities prior to committing resources to certain types of projects. The purposes and requirements of the two statutes are summarized in the following subsections. Also presented is a list of contacts in the regional and field offices of the US Fish and Wildlife Service.

11462 **(ORNL/M—261) Environmental Compliance Program reference book: Safe Drinking Water Act.** (Oak Ridge National Lab., TN (USA)). 15 Aug 1986. Contract AC05-84OR21400. 327p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87003942.

The Safe Drinking Water Act (SDWA) is an environmental statute for protecting water resources that can affect the US Department of Energy. Primary drinking water standards promulgated under the SDWA apply to drinking water "at the tap" as delivered by a public water supply system. As such, the standards are directly applicable to DOE to the extent that DOE facilities act as public water supply systems. Of greater significance to DOE is that the drinking water standards are used to derive groundwater protection regulations under a number of other statutes. States are given primary enforcement authority for the SDWA. In certain circumstances, states may grant variances and exemptions from the national regulation. For example, many of the regulations affecting groundwater provide for exemptions, variances, or alternate concentration limits. Typically, cost, benefits, alternatives, public interest, and the protection of human health and the environment are considered. Thus, if DOE believes that direct application of a drinking water standard for groundwater protection is not justified on the basis of expected risk to the public at a specific site, the opportunity exists for DOE to request an exemption, variance, or alternate concentration limit. Many changes to the SDWA were made when it was reauthorized on June 19, 1986. Details regarding these statutory changes may be found in the section on the Act's legislative history.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 10693, 10766, 10793, 10797, 10818, 10835, 10862, 10863, 10863, 10864, 10865, 10866, 10868, 10884, 10885, 11160, 11161, 11162, 11163, 11164, 11165, 11433

11463 **(DOE/EIA—0035(86/09)) Monthly energy review, September 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 29 Dec 1986. 135p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87003896.

US energy production in the first three quarters of 1986 was 48.2 quadrillion British thermal units (Btu), 0.6% below the level in the first three quarters of 1985 (summary table). Consumption of energy totaled 55.2 quadrillion Btu, down slightly from the 1985 level. Net imports totaled 7.3 quadrillion Btu, up 29.5% from the level in the first three quarters of 1985 but below the all-time high for first-three-quarter net imports (13.7 quadrillion Btu) reached in 1977.

11464 (EPRI-EA—4857, pp 20.1-20.11) **Canadian energy export policy.** Sully, R.R. (Energy, Mines, and Resources Canada, Ottawa, Ontario). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Energy trade between Canada and the US has been very important to both countries. Recent energy policy initiatives in Canada provide a framework within which our energy trade should continue to grow. These developments are reviewed, and some issues that may arise in the context of enhanced energy trade between Canada and the US are examined.

11465 **(ORNL/TM—10157) The Research and Development Analysis Modeling System World Natural Gas Model (RAMSGAS): Final documentation.** Browne, E.A.; Reister, D.B.; Trowbridge, L.D.; Conopask, J.V.; Hicks, E.; Mihlmester, P. (Oak Ridge National Lab., TN (USA)). Dec 1986. 77p. NTIS, PC A05/MF A01. File Number DE87004055.

The Research and Development Analysis Modeling System World Natural Gas Model (RAMSGAS) was developed for the US Department of Energy, Office of Advanced Fuels, Technology, Extraction, and Environmental Controls, to support planning of unconventional gaseous fuels R and D. The DOE decided that a framework was needed that would allow analysts to easily vary assumptions about future world natural gas markets. The model is a scenario analysis tool constructed for IBM PC compatible microcomputers. The model structure is based on a traditional supply/demand framework, and also accounts for the non-renewable nature of gas resources. The model estimates consumption, production, and prices in each region every 5 years for conventional and unconventional natural gas, and oil. Demand for oil and gas is determined by energy growth rates and price-induced conservation, for each of the 9 demand regions which partition the world. Once demand estimates are established in each region, a share of that demand is allocated to natural gas, depending on the average gas price relative to projected oil prices. Gas is supplied by 11 conventional and 19 unconventional sources and market shares are determined according to relative delivered prices. Scenarios can be changed, saved, and retrieved easily and the results accessed through automatic printing and graphics routines. 10 refs., 12 figs., 24 tabs.

11466 **(ORNL/TM—10159) A comparison study of the RAMSGAS Model and the National Energy Policy Plan projections to 2010.** Browne, E.A.; Reister, D.B.; Trowbridge, L.D. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004022.

This report documents the results of a validation exercise comparing the RAMS World Natural Gas Model to the National Energy Policy Plan Projections to 2010. The purposes of this study are twofold: (1) determine the changes necessary to RAMSGAS input parameters to duplicate NEPP-85 results; and (2) test the flexibility and robustness of the RAMSGAS model by demonstrating its capability to produce results higher than the NEPP-85 high growth case, and lower than the NEPP-85 low growth case. Four scenarios were developed for the study: a reference scenario, NEPP-match scenario, and high and low growth scenarios. The changes made to RAMSGAS in this study were to the numerical values of the parameters only; no equations were altered. Comparisons were made between projections of world oil and natural gas prices and production through 2010. The results of this study show that RAMSGAS is easily capable of duplicating the long-term trends of the NEPP-85 study. Short term behavior could only be duplicated by large adjustments to RAMSGAS parameters, and not all parameters could be exactly matched. 2 refs., 9 figs., 7 tabs.

11467 **Oil from shale: The potential, the problems, and a plan for development.** Lewis, A.E. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). pp 101 of Energy: For ourselves and our posterity. Perrine, R.L.; Ernst, W.G. Old Tappan, NJ; Prentice Hall, Inc. (1985).

A unitized management and development of the government-owned oil shale will make it technically and economically practical to obtain very large production rates (1 to 5 x 10/sup 6/ bbl/day) of shale oil from this source. The estimated price is below world prices and could be less than $15 per barrel. Private oil shale lands, on the other hand, provide a smaller, though still important potential for production in terms of resource size and economic cost. Important differences exist in the nature of the oil-shale resource held by the government and that held by private companies. These differences are crucial not only in estimating production costs and incentives necessary for production but also in defining applicable technology.

2960 Electric Power

REFER ALSO TO CITATION(S) 11156, 11157, 11158, 11159, 11166, 11173, 11464, 11572, 11576, 11585

11468 **(DOE/EIA—0226(86/09)) Electric power monthly, September 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 11 Dec 1986. 48p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. File Number DE87003897.

In September 1986, nuclear-powered generation represented a record level of 17.7% of the total electricity produced during the month. Nuclear net generation in September 1986 increased 6%

over September 1985 to 36,593 gigawatthours, the second largest level ever reported for a single month. Petroleum net generation increased nearly 44% in September 1986 over September 1985 to 10,676 gigawatthours. However, the percentage share of petroleum net generation to total net generation was only 5.2%.

11469 (EPRI-EA—4857, pp 21.1-21.26) **Regional electricity exports: current status and overview of the issues.** Douglas, G.W.; Battle, E.F. (Canadian Energy Research Institute, Calgary, Alberta). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

Imports of electric power from Canada into the US have grown dramatically over the past decade. These imports allow US purchasers to reduce their dependence on costly oil-fired generation, and can act as a stop gap measure by which domestic capacity expansion may be deferred. Recently, there has been a trend towards greater purchases of firm power and energy, and proposals have been made for pre-building of Canadian generating facilities to serve US markets. At the same time, certain American interests have expressed concern about reliance on foreign sources of energy supply and about the linking of Canadian export prices to the cost of imported oil. The electricity trade question is examined, with an emphasis on regional issues and market differentiation. The purpose is not to attempt an in-depth quantitative analysis of potential US import demands and Canadian export volumes. Rather it is to provide an overview of how electric power exchanges have evolved in the various interconnected regions, of the prospects for different kinds of exchanges in the future, and of the contractual, institutional and other issues involved in realizing electricity trade between Canada and the US.

11470 (EPRI-EA—4857, pp 22.1-22.8) **Canadian electricity purchases by northeastern utilities.** Weiner, B.H. (J. Makowski Associates, Inc., Boston, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

The recent developments regarding energy imports from Canada to markets in New England and prospects for future electric power from that source are examined. Since the turn of the century electric power transmission lines have connected Canada and the US. The international exchanges have been based on benefits flowing in both directions. There are presently over 100 international power lines ranging from 115 kV to 765 kV carrying electricity to both sides of the border. Several of these interconnections are between Eastern Canada and New England. The major New England tie currently in use is a 345 kV line capable of carrying 700 MW in to or out of New England from New Brunswick. There are also several lower voltage ties in Maine and Vermont. With the existence of an abundance of energy sources in Canada and the over-dependence on oil in New England, there are substantial opportunities to advance the economic interests on both sides of the international border through sound and mutually beneficial business energy transactions.

11471 (EPRI-EA—4857, pp 23.1-23.8) **Midwest electric energy imports.** Barrett, L.R. (Northern States Power Co., Minneapolis, MN). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920008. (CONF-851032—).

From Fuel supply seminar; San Antonio, TX, USA (8 Oct 1985).

The power requirements of Midwestern utilities influence the scale of electrical energy imports from Canada. The region examined consists of the utilities operating in two of the nine National Electric Reliability Councils. The two Canadian provinces participating in these councils are Saskatchewan and Manitoba. The US utilities operate in the states of North Dakota, south Dakota, Nebraska, Minnesota, Iowa, Wisconsin, Illinois and portions of Missouri and Montana.

11472 (EPRI-EA—4944-Vol.1) **Strategies for coping with drought: Volume 1, Problem identification: Final report.** Lettenmaier, D.P.; Leytham, K.M.; Palmer, R.N.; Johnston, D.M.; Burges, S.J. (Washington Univ., Seattle (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 186p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920158.

Drought has significant direct and indirect effects on both steam electric and hydroelectric generation. The research reported in this volume (Part I) summarizes the results of telephone and in-person interviews with 47 electric utilities, regulatory agencies and consulting firms, as well as a literature review, which identify the extent of drought problems affecting the electric utility industry. Three areas were targeted for future research inquiry and technology transfer, which are addressed in Part II (a separate volume).

11473 (EPRI-EM—4884) **Data collection and estimation for multiple-account and mixed-use facilities: A monograph from the COMSURV Project: Final report.** Looney, Q.; McCarthy, P.M. (Applied Management Sciences, Inc., Silver Spring, MD (USA)). Nov 1986. 43p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920125.

This report provides a descriptive illustration of the Multiple Account and Mixed Use Problems. Using hypothetical data based on actual building populations, potential solutions are described and illustrated. Frame treatments, such as multiple account matching, are illustrated. Sample adjustments, such as use of the Rao and Ratio estimators are also illustrated. The premise concept is used. A Control Space concept is introduced to reconcile account energy which is shared between different premises.

11474 (TVA/OP/EUDR—86/7) **1985 commercial and industrial survey: Customers of municipal and cooperative distributors of TVA [Tennessee Valley Authority] power.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Use and Distributor Relations). Sep 1986. 60p. NTIS, PC A04/MF A01. File Number DE87900340.

The 1985 Commercial and Industrial Survey was undertaken to provide information about the general power customers served by the 160 local distributors of TVA power. Separate estimates were provided for commercial buildings and industrial establishments, including major activity type, energy end-uses, energy conservation measures, and building or establishment characteristics. Information about waste heat recovery and cogeneration and self-generation of electricity was also obtained for industrial establishments.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 10885, 11432, 11452, 11572

11475 (EPRI-EM—4989) **Directions for future commercial survey research: A COMSURV monograph: Final report.** McCarthy, P.M.; Bernstein, H.M. (Applied Management Sciences, Inc., Silver Spring, MD (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 47p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920172.

A panel of reviewers experienced in the use of commercial customer surveys and end-use forecasting models identified improvements in survey design that would allow analysts to more accurately characterize the commercial sector. The recommended enhancements would also increase the forecasting reliability of models using the data.

11476 (NP—7900318) **Energy use in Kenya industry, 1983: A survey and analysis of industrial energy consumption.** Jones, H.M.; Baiya, H. (International Energy/Development, Inc.). 25 Jun 1985. 64p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87900318.

This report contains the results of a survey of the energy use and industrial production of over 150 major industrial firms in

Kenya. Purposes of the survey are to assist in establishment of sound National energy policies, to identify energy conservation and fuel substitution opportunities, and to generally better understand how and where fuels are being used in order to ensure that energy is available where, when and in the form needed. This report provides a review and analysis of industrial energy use data by industry sector, and complimentary indicators of economic performance for each sector. Estimates are provided of National total industry fuel consumption based on survey data and related statistics. The report also presents indicators of the energy intensity of each manufacturing sector, as well as an estimate of the cost of energy versus other inputs to production for each sector.

11477 **(NP—7900438) Alaska electric power statistics, 1960-1985: Eleventh edition.** (Alaska Power Authority, Anchorage (USA)). Dec 1986. 66p. Alaska Power Authority, P.O. Box 190869, 701 E. Tudor Rd., Anchorage, AK 99519-0869. File Number TI87900438.

This is the eleventh in a series of statewide electric power data summaries. This publication includes data on electric utility systems, national defense installations and industrial facilities, which supply power for their own use. Tables and graphs provide energy use by regional areas of the state, fuel types, types of generation equipment and many other perspectives. A five year summary of installed capacity and net generation for the utility, industry and military sectors plus energy sources and percentages of growth between years are tabulated. At the end of 1985, statewide installed generating capacity totaled 2304 megawatts, a drop of 46 megawatts from the 1984 figure. This change may be attributed to 1985 reporting from the military sector, which excluded some of their facilities in the Yukon region of the state. Seventy percent of 1985 installed capacity was in the utility sector, seven percent in the military sector and twenty-three percent in the industry sector. Statewide, installed capacity in 1985 was 16% higher than the 1981 figure.

11478 **Urban energy use in the developing countries.** (Lawrence Berkeley Lab.). pp 676-690 of Proceedings of the Seventh Annual North American Meeting, International Association of Energy Economists. Thompson, W.F.; DeAngelo, D.J. Boulder, CO; Westview Press, Inc. (1985). (CONF-851285—).

From 7. annual North American meeting of the International Association of Energy Economists; Philadelphia, PA, USA (10 Dec 1985).

Patterns of energy use in the cities of the developing countries have undergone considerable change during the past two decades. These changes are closely linked to growth in household income, which has allowed the acquisition of devices that use modern fuels. A major area of change has been in cooking, where use of traditional fuels like wood has given way to use of kerosene, LPG, and electricity. The other key development in homes has been the growth in ownership of electric appliances. These include some devices, like refrigerators, water heaters, and air conditioners, that substantially increase household electricity demand. A striking feature of both energy use in the home and in transportation is the large difference in the amount of energy used by households at different socio-economic levels. Major segments of the urban population in many cities own few appliances, and use most of their energy for cooling. For transport they either walk or use mass transit. In many cities, a small proportion of the households account for a large share of the use of modern fuels, especially electricity. The extent to which lower-income households move into more electricity-intensive lifestyles will depend very much upon both general income growth and income distribution.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 11101, 11102

11479 **(EUR—10387-IT) Investigation of energy consumption and availability of alternative energy sources. Final report.** Lentiri, F. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 152p. (In Italian). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energia.

The activity concerning the research programme will consist in: 1. Characteristics of present energy consumers (quantity and kind) on an internal territory of Sicilia; region of Madonie (about 40 kmx30 km); region of Accamo (about 16 kmx20 km); This involves a total of 450 farms in an especially advantageous area; 2. The characteristics of local energy sources (quantities and kind); 3. The analysis of local energy needs (quantity and kind) with emphasis on improving the living conditions and developing the area; 4. The evaluation of possibilities and aptitudes to use alternative energy sources in order to reach the objectives of item 3. In this context the following possibilities will be examined: solar thermal technology (warm water, drying, etc.); biomass conversion technology (biogas, gasification, pyrolysis, etc.); photovoltaic and wind energy production technologies for different applications such as light, pumps, drinking water, forest fire warning, irrigation monitoring systems, etc.); 5. Project for the realisation of small pilot plants.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

11480 **(DOE/ET/10815—115) [Operation of MHD coal fired flow facility]: Quarterly technical progress report, January-March 1986.** (Tennessee Univ., Tullahoma (USA). Space Inst.). Dec 1986. Contract AC02-79ET10815. 33p. (UTSI—86-09). NTIS, PC A03/MF A01; GPO Dep. File Number DE87003148.

Results of testing and development on the components required for the steam bottoming plant of an MHD steam power plant are reported. Development of a two-dimensional model of the flow and heat transfer in the radiant furnace for comparison with measured temperatures and heat fluxes is discussed. No actual testing in the CFFF was performed during this quarter due to the winter weather shut down. Plans for testing in the next quarter are discussed. Finally, the status of ongoing studies and analyses, including system performance, environmental and seed recovery studies is reported. Facility modifications discussed include installation of the air compressors, facility winterization and installation of both spent seed and raw seed storage facilities. 9 refs., 13 figs.

11481 **(DOE/ET/15601—20) Diagnostic development and support of MHD test facilities: Technical progress report for the period January, February, March 1985.** Shepard, W.S.; Cook, R.L. (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Apr 1985. Contract AC02-80ET15601. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003100.

Mississippi State University is developing diagnostic instruments for MHD power train data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments, initially developed for HRSR support, are being refined, and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with MHD Energy Center computers. Additionally, technical support of the diagnostic needs of the national MHD research effort is being provided.

11482 **(DOE/ET/15601—T19) Diagnostic development and support of MHD test facilities: Monthly progress report, November 1-30, 1986.** (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). 10 Dec 1986. Contract AC02-80ET15601. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003348.

Diagnostic techniques for MHD generators being developed at Mississippi State University are described briefly. (LTN)

11483 **(DOE/ET/15601—T20) Diagnostic development and support of MHD test facilities: Quarterly technical progress summary.** (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). [1987]. Contract AC02-80ET15601. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003357.

The major accomplishment was the successful design, construction and testing of the modified forward-scatter traverse mechanism. The design was changed from a free standing platform to a rail assembly which attaches directly to the MHD channel side. The assembly was tested on the MSU test facility during October and performed very well. The unit has a traverse distance of approximately 24 inches. The two LDV signal processes (frequency counters) were returned to TSI, Inc. in November for repair and recalibration. They are due to be returned by January 10, 1987. Preparation was made for the field test scheduled at Butte, Montana, in early 1987.

11484 **(DOE/PC/70512—5) Develop and test an internally cooled, cabled superconductor (ICCS) for large scale MHD magnets: Analysis report.** Hatch, A.M.; Marston, P.G.; Tarrh, J.M.; Becker, H.; Dawson, A.M.; Minervini, J.V. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jan 1986. Contract AC22-84PC70512. 50p. (PFC/RR—86-5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003101.

A three-year program to develop and test an internally-cooled cabled superconductor (ICCS) for large-scale MHD magnets is being performed by MIT for the Pittsburgh Energy Technology Center (PETC) under contract DE-AC22-84PC70512. Included in this report are electromagnetic, thermodynamic, structural, protection, and systems analyses, completed as required to substantiate the preliminary conductor design requirements definition and the associated preconceptual magnet design developed in Task I. Copper-stabilized NbTi superconductor was selected at the outset as being most suitable for the application. The analysis necessary to substantiate the preconceptual MHD magnet design is complete, including field and force calculations, preliminary structural analysis, thermodynamic (cryogenic) analysis, and the analysis of the magnet electrical and protective systems. A significant result of the field analysis is the determination that maximum fields to which the conductor is exposed in the magnet are considerably higher than originally expected. Changes were made to produce a revised design in which the maximum field is 6.9 T (53% above central field) and adequate stability is ensured. Analysis necessary to substantiate a preliminary conductor design requirement definition for full-scale conductor has been completed except that further work is required to establish maximum allowable internal flow resistance and maximum length between vents. Procedures for accomplishing these analyses have already been developed at MIT and by other contractors. 11 figs., 11 tabs.

11485 **Results from design analyses of an MHD generator for a prototype MHD power train suitable for retrofit of an existing steam power plant.** Hals, F.A.; Pian, C.C.P. (Avco Research Lab. Inc., Everett, MA 02149). pp 121-130 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

Results from analyses of MHD power trains for early commercial power plant applications conducted in the APT program have been presented at previous MHD Symposia. This paper presents results from more recent investigations of a MHD generator for a prototype MHD power train suitable for retrofit of the Montana Power Company Frank Bird Steam Power Plant of nominal 66 MW/sub e/ capacity. The paper reviews the design approach and presents preliminary design and performance data developed for this prototype retrofit MHD generator. The work reported on was conducted in the final phase of the APT design analyses in connection with an evaluation of different MHD program development options and the identification of a preferred plan for the development of commercial MHD power trains.

11486 **Thermal radiation in MHD design applications.** Wang, C.S.; Chow, L.S.H. (Magnetohydrodynamics Program, Argonne National Lab., Argonne, IL 60439). pp 202-212 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—). Contract W-31-109-ENG-38.

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The results of scale-up calculations on total gas emissivity from combustion gases containing carbon dioxide, water vapor, potassium atoms, and submicron-size slag particles are provided. A correlation equation to calculate total gas absorptivity and corrections to account for a gray surface are also presented. Measured data on the temperatures and emissivities of a surface covered with seed-slag are also included. A significant effect of potassium atoms and slag particles on total gas emissivity (especially at higher temperatures) is concluded. These calculated data, based on partially validated theoretical models, are approximate for MHD design applications and are presented in a form suitable for use by a design engineer.

11487 **Data analysis of diagonally-connected magnetohydrodynamic power generator experiments.** Pian, C.C.P.; McClaine, A.W. (Avco Research Lab. Inc., Everett, MA 02149). pp 3-11 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics;. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The data from diagonally-connected MHD generator experiments at the Avco Mk VI facility and at the Component Development and Integration Facility have been compared with analyses. The results of the comparisons were used to study the slagging effects on the generator performance as a function of the various operating conditions. The cathode interelectrode voltage nonuniformity was found to be the most important effect in reducing the effective axial slag impedance of the generator. An electrical model of the diagonally-connected MHD generator with external linkage resistors was formulated to assist in the data analysis. The electrical model is also described in the paper.

11488 **Advanced power train electrical stress simulation in the AVCO MK VI Test Facility.** McClaine, A.W.; Swallom, D.W. (Avco Research Lab. Inc., Everett, MA 02149). pp 18-23 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

A series of tests was performed in the Avco Mk VI MHD test facility to simulate the electrical stresses, including the Hall parameter, predicted for large scale MHD generators such as those investigated in the Advanced Power Train studies. The data was analyzed with the help of the Avco MHD4 computer model. The analysis confirms that electrical stresses similar to those expected in baseload power plants were achieved. Under these stresses the generator performed smoothly and reliably. No unforeseen problems were experienced.

11489 CDIF status report: Coal-fired MHD power generation tests. Lowry, W.E. (Component Development and Integration Facility, Butte, MT). pp 24-32 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

A status report on test progress at the Component Development and Integration Facility (CDIF) is provided to detail MHD power generation test results. Recently, a 50-MW/sub t/ coal-fired combustor was installed in conjunction with the MHD generator; test results integrating these two components are presented. These test components were operated for a series of tests over a range of conditions for several hours. Successful operation of this coal-fired train is an important step in a Department of Energy funded program directed toward the design and operation of an MHD demonstration plant. Test results presented include a general overview of the CDIF coal-fired MHD testing since the last SEAM conference. During these tests, MHD power from the coal-fired combustor tests was transmitted via an inverter to the commercial power grid, representing a significant achievement in the evaluation of MHD. Facility support system operations, with particular attention to coal and potassium carbonate injection and measurement, are discussed. These test results demonstrate significant progress of the coal-fired MHD technology development toward commercialization, in that they can be used to verify theoretical estimates of MHD power train performance at the 50-MW/sub t/ scale. These results verify engineering feasibility of MHD power generation and provide data necessary for scaleup of the process.

11490 A 50 MW/sub t/ slag rejector development and design. Roy, G.D. (TRW Space and Technology Group, Redondo Beach, CA 90278). pp 131-136 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

Ir order to be able to operate the MHD channel in a continuous power generation mode, the slag rejected from the coal combustor must be isolated from the high electric potential generated by the channel, and removed continuously from the system. Tests have been conducted on an experimental slag rejector system simulating the slag flow and electrical potential of the 50 MW/sub t/ coal combustor system currently being tested at the Component Development and Integration Facility (CDIF) at Butte, Montana. The components selected for the slag rejector have been tested for their operational characteristics and reliability. Data obtained from the development tests were used as the basis for the detail design of a slag rejector system to be used with the 50 MW/sub t/ TRW combustor at CDIF.

11491 CFFF LMF radiant furnace modelling. Lineberry, J.T.; Lee, J.J.; Galanga, F.L. (The Univ. of Tennessee Space Institute, Tullahoma, TN). pp 142-155 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The paper discusses aspects of research which have been conducted at UTSI in the development of modelling and analyses techniques for use in evaluation of the CFFF radiant furnace. It reviews the radiant furnace design and recounts its past operation in CFFF LMF testing. These reviews are used to identify some of the physical and mathematical complexities which must be addressed in the development of usable modelling methods for analyzing the furnace. Past and present furnace modelling at UTSI is reviewed. Two principal models are detailed, a 1-D heat transfer computer code that has been used in past analyses and a 2-D gas dynamic and heat transfer computer code which has more recently become available. The later method is an extension to previous work in analyzing MHD diffusers. Results of selected calculations from these methods are given and compared to available experimental data. The significance of these results and the limitations of the analytical methods to model furnace operation are delineated.

11492 The effects of impinging particle-laden gas jets on the potential for burnout in an MHD radiant boiler. Berry, G.F.; Wang, C.S.; Choi, U.S. (Magnetohydrodynamics Program, Argonne National Lab., Argonne, IL 60439). pp 167-176 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The potential burnout of the backwall of the radiant boiler by a high temperature particle-laden impinging jet has been analyzed for both CFFF and retrofit sized MHD plants. The analysis indicates that the decay of gas velocity and temperature will be negligible as a result of the short distance between the diffuser outlet and the backwall. It is concluded that, based on the present CFFF and retrofit radiant boiler design, the backwall will be susceptible to burnout because of the high temperature of the gas entering the radiant boiler. This high diffuser exit gas temperature does not have sufficient distance to cool down before impinging on the backwall. If the particle loading is higher and/or the refractory melting temperature is lower than assumed, the potential burnout problem becomes even more severe. The formation of a slag layer on the refractory surface will mitigate the burnout problem if the slag layer can form in the region of high jet velocity. However, because of the molten form of the slag layer which may be easily blown away, this improvement could be small.

11493 HRSR component testing at the CFFF during 1985. Foote, J.P.; White, M.K. (The Univ. of Tennessee Space Institute, Tullahoma, TN 37388). pp 177-186 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

Results of 1985 testing at the Coal Fired Flow Facility relating to heat recovery/seed recovery components are given. Test results for the Super-heater Test Module, Baghouse and Electrostatic Precipitator are discussed.

11494 Recent ANL data on MHD fouling. Chow, L.S.H.; Wang, C.S.; Swift, W.M. (Magnetohydrodynamics Program, Argonne National Lab., Argonne, IL 60439). pp 187-195 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—). Contract W-31-109-ENG-38.

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

Sixteen tests have been completed to investigate the effect of (1) gas temperature, (2) entrained species-K/sub 2/SO/sub 4/, fly ash, and K/sub 2/CO/sub 3/, and (3) sootblowing period on the characteristics of MHD fouling. At a gas temperature up to about 150 K above the K/sub 2/SO/sub 4/ melting point, the ash-free deposits of K/sub 2/SO/sub 4/ were found to be hard and dense, and they could be difficult to remove. This finding is similar to the reported results of ash-free deposits of K/sub 2/CO/sub 3/ in MHD gas-fired systems. Deposits of K/sub 2/SO/sub 4/ and fly ash appear to become less troublesome as the amount of ash in the deposit increases. An increase in ash concentration results in a more porous MHD deposit that might be more readily removed. The presence of potassium carbonate as an impurity in a deposit of K/sub 2/SO/sub 4/ does not cause an observable difference in deposit characteristics as compared with a deposit of K/sub 2/SO/sub 4/ and ash. The test results support the hypothesis that the strength and tenacity of the deposit increase with local gas temperature, local heat flux, and length of time the deposit is exposed to the hot gas. The deposition and heat transfer model developed at ARgonne National Laboratory was further validated by comparing calculated values of heat transfer and deposition rates to the fouled tubes with the measured data.

11495 **Status of material disposition studies at the coal fired flow facility.** Jackson, D.M.; Holt, J.K. (The Univ. of Tennessee Space Institute, Tullahoma, TN 37388). pp 196-201 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

A discussion of the nature and distribution of elements throughout the Coal Fired Flow Facility is given. Emphasis is placed on the collection and recovery of spent potassium seed. A material balance computer code has been developed to calculate balances for both gases and solids in the flow train.

11496 **50 MW/sub t/ combustor performance characteristics.** Braswell, R.; Iwata, H.; Scinto, L.; Solbes, A. (Applied Technology Div., TRW Space and Technology Group, Redondo Beach, CA 90278). pp 213-223 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The coal-fired power generation test program conducted at the Component Development and Integration Facility (CDIF) has provided insight into the performance characteristics of the integrated 50 MW/sub t/ MHD Coal-Fired Combustor (CFC) and power train. This paper presents data generated during the power train test series which relate specifically to the performance of the 50 MW/sub t/ CFC in terms of heat loss, slag recovery, conductivity and power. CFC performance at CDIF is compared with 1) theoretical predictions, 2) CFC performance during the design verification test program at TRW and 3) the oil-fired Ash-Injected Combustor (AIC) performance at the CDIF. An analysis of the data addressing specifically seed vaporization/ionization efficiency and combustion efficiency is also presented.

11497 **A laser-based instrument for measurement of particle-size distributions.** Gassaway, J.D.; Stapp, R.W. (Research Scientist, MHD Energy Center, Professor, Electrical Engineering, Mississippi State Univ., MI). pp 229-243 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The instrument discussed is based upon the principles of forward scatter of a laser beam by a single particle. Three beams are used to illuminate the particle. The green central beam is used to measure particles in the range of two to fifteen microns in diameter. Two crossed blue beams are used to measure smaller particles, to provide a velocity measurement, and to validate the trajectory of larger particles through the green beam. Therefore the distribution of the larger particles is constructed from data that is free of the trajectory ambiguity. A range of sizes from approximately 2 microns to 15 microns in diameter can be measured, and number density values of up to 4 x 10/sup 4/ per cc can be resolved using this technique. The distribution of particles smaller than 2 microns in diameter is obtained from the amplitudes of ripple signal measurements that correspond to visibility parameter values greater than a prescribed limit. A statistical analysis of the measured counts is used to generate the distribution. Number density values of up to 4 x 10/sup 6/ per cc can be resolved using this method.

11498 **Coal flow splitting-control and measurement.** Stewart, J. (Applied Technology Div., TRW Space and Technology Group, Redondo Beach, CA 90278). pp 244-250 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The design, build-up and testing of a coal flow measurement and control system for use with the MHD low preheat combustor system are discussed in this paper. The system splits and measures two coal flows from a single pressurized hopper to supply coal to the vitiator and first stage. A brief description of the coal flow measurement devices considered for this design and their integration into the existing coal feed system are discussed. All tests to date have been performed with Montana Rosebud seam coal in an existing coal system that has been modified for these tests. The mechanical and electrical hardware are discussed together with a brief discussion of the software.

11499 **Three-dimensional MHD flow in the CDIF powertrain.** Demetriades, S.T.; Maxwell, C.D.; Oliver, D.A. (STD Research Corp., Arcadia, CA 91006). pp 66-78 of Proceedings of the 24th symposium on engineering aspects of magnetohydrodynamics. Staats, G.E. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860663—).

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

Initial three-dimensional simulations of feasible operating conditions of the CDIF powertrain are reported. The results of these simulations indicate the presence incipient magnetoaerothermal (MAT) current constriction on the anode centers under some conditions. The current constrictions studied are quenched by the cool boundary layer gas convected by secondary flows. Parametric studies of a generalized MAT stability criterion indicate directions for future experiments in order to induce, isolate and study the MAT current constriction in the CDIF facility.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 12001

11500 **Fabrication of three 2500-watt (thermal) strontium-90 heat sources.** DeVore, J.R.; Haff, K.W.; Tompkins, J.A. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 1374-1380 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Three 2500-watt (thermal) heat sources were fabricated by the Oak Ridge National Laboratory (ORNL) for the purpose of fueling a 500-watt (electric) thermoelectric generator as part of the U.S. Department of Energy's Byproducts Utilization Program (BUP). Each of the sources, which are the largest ever assembled, consist of hot-pressed pellets of /sup 90/Sr fluoride, doubly encapsulated in three Haynes-25 inner capsules and in a Hastelloy-S outer capsule. The total /sup 90/Sr inventory of all three sources is 1.12 million curies. The sources were fabricated at the ORNL Fission Product Development Laboratory(FPDL), which is a facility that is capable of processing multi-megacurie quantities of radiactive materials, chiefly /sup 137/Cs and /sup 90/Sr. The facility has been used for the fabrication of selated sources of radiactive materials since the 1960's. The source was tested to determine compliance with all of the IAEA Safety Series No. 33 requirements. The source fabrication, assembly, and testing are described in the presentation.

3004 Thermionic Converters

REFER ALSO TO CITATION(S) 11598, 11599

3005 Fuel Cells

REFER ALSO TO CITATION(S) 11684

11501 **(AD-A—172750/2/XAB) Advanced diesel-oil fuel-processor development. Final report, 16 October 1984-21 May 1986.** Murray, A.P. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jun 1986. 171p. (—86-9B3-THERM-R1). NTIS, PC A08/MF A01.

The Westinghouse R & D Center has been conducting a fuel-processing program for Army phosphoric-acid fuel-cell (PAFC) systems, with the objective of an advanced system that uses diesel fuels and does not require an external water source. An autothermal reforming approach is followed, and six design variations proposed. Analyses and experimental tests have been performed and indicate this is a viable technical approach. However, the diesel-fuel-cell system is estimated to be considerabiy heavier than its methanol-fuel counterpart, which will limit its use for mobile and portable-power applications.

11502 **(CONF-840302—8) Cogeneration of electric power and nitric oxide in a solid-electrolyte fuel cell.** Manton, M.R.S.; Sawin, H.; Scharfman, R.M.; Sigal, C.; Vayenas, C.G.; Wei, J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 19 Mar 1984. Contract AC02-80ER10694. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003923.

From 11. annual energy technology conference and exposition; Washington, DC, USA (19 Mar 1984).

Electrochemical reactors may be operated as fuel cells to produce electrical power directly, avoiding Carnot cycle inefficiencies. In a fuel cell, costly fuels are "burned" to valueless oxidation products. There are a number of exothermic reactions, including the oxidation of ammonia to nitric oxide, that may be performed in a fuel cell thus "cogenerating" electric power and valuable products. The oxidation of ammonia to nitric oxide has been investigated at temperatures of about 830°C over porous platinum films deposited on the walls of an yttria-stabilized-zirconia (oxygen anion conducting, solid-electrolyte) fuel cell. The rate determining step is conduction of the O^{2-} anions through the electrolyte which is controlled by the resistance of the external electrical circuit. Fluxed and unfluxed platinum and platinum-rhodium inks have been used to prepared the electrodes. Maximum power densities of 2.75 mW/cm² have been achieved with a conversion of ammonia of 30% and selectivity to nitric oxide of 42%. Selectivities of 97% at conversions of 39% have also been achieved, but at power densities of 0.61 mW/cm². 16 refs., 5 figs.

11503 **(DOE/MC/21167—2080) High temperature coal gas chloride cleanup for molten carbonate fuel cell applications: Final report.** Krishnan, G.N.; Tong, G.T.; Wood, B.J.; Korens, N. (SRI International, Menlo Park, CA (USA)). Nov 1986. Contract AC21-84MC21167. 142p. NTIS, PC AA07/MF A01; 1; GPO Dep. File Number DE87001041.

The use was investigated of natural minerals and commercial sorbents to remove HCl vapor contaminant from high temperature coal gas mixtures used for molten carbonate fuel cell (MCFC) applications. Sodium carbonate-based sorbents can reduce the level of HCl to about 1 ppM in coal gas streams at 535 to 650°C. In the laboratory-scale phase of this study of three minerals and two commercial sorbents, the total capacity of the sorbent for retaining HCl was found to depend on its sodium content and porosity. The mineral nahcolite after calcinatin was found to have a capacity of 54 wt % chloride because of its high sodium content and moderate porosity. Although commercial sorbents have high surface areas, they had much lower chloride capacities because of their low sodium content. The reaction between HCl vapor and the sorbents was rapid and the initial rate was controlled by gas phase mass transfer. The bench scale phase of this study conducted with simulated "simple" coal gas containing only HCl as an impurity and a "complex" coal gas containing H_2S, organic, and trace metal impurities in addition to HCl confirmed the results of the laboratory study. H_2S was captured by the sorbents only in minor quantities and it did not interfere with the chloride removal. Arsenic and antimony were the trace metal impurities significantly retained by the sorbents. Preliminary techno-economic analysis of the HCl removal process identified nahcolite as the most economic sorbent. Capital and operating costs for a 100-MWe commercial size unit were estimated to range from $0.0017 to $0.0031 per kWh depending on the type of gasifier.

11504 **(DOE/MC/22224—2202) Nickel transport in molten carbonate fuel cell electrolytes: Final report.** Remick, R.J. (Institute of Gas Technology, Chicago, IL (USA)). Nov 1986. Contract AC21-85MC22224. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001036.

Cathode dissolution occurs predominantly by an acidic mechanism in binary lithium/potassium carbonate electrolytes having from 50 to 75 mole percent lithium carbonate. The cathode attrition can be reduced by increasing the basicity of the electrolyte. The amount of nickel, which is transported into the matrix is directly proportional to the partial pressure of carbon dioxide in the oxidant. Nickel dissolved in the electrolyte can survive passage through the electrolyte matrix to reach the anode. The proportion of dissolved nickel surviving to reach the anode compared to the nickel deposited in the electrolyte increases with increasing basicity of the melt. Because of the small quantities involved, nickel transport from cathode to anode does not appear to represent a problem with respect to cell durability. The best explanation for the results observed in these experiments is that the nickel oxide cathode dissolves in the electrolyte via two mechanisms.

11505 **(EUR—10595-EN) Potential, state of the art and R and D requirements for fuel cells in the European Community. Proceedings.** Zegers, P. (ed.). (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 217p. (CONF-8510381—). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The CEC fuel cell workshop held on 7 and 8 October 1985 in Noordwijkerhout in the Netherlands was organized in collaboration with the Dutch Office for Management of Energy Projects (PEO). Results of the CEC funded market study for phosphoric acid fuel cells and of the PEO funded market study for molten carbonate fuel cells formed an important part of the workshop. Further on papers were presented on fuel cell activities in Italy and the Netherlands and on the state of the art of fuel cells and fuel processors. During the workshop thirteen papers were presented, which introduced the topics discussed in five working groups (1. applications, 2. market potential, 3. molten carbonate fuel cells, 4. phosphoric acid fuel cells, 5. other fuel cells). Separate abstracts were prepared for nine papers.

11506 (EUR—10595-EN, pp 26-53) **Phosphoric acid fuel cell for electrical power generation: Development and penetration in the EEC countries.** Sabbioni, F.; Imbimbo, E.; D'Ignazio, P.D.; Steel, M.C.F.; Ryan, F.J.; Pilkington, C.E. (TESI s.r.l., Milan, Italy; Johnson Matthey and Co. Ltd., London, UK). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The objective of this study is to assess the potential market for PAFC for electrical power generation in EEC Countries and to analyze the factors influencing future market penetration. The countries of the European Community in contrast with their geographic and economic unity are very diversified internally. The study analyzes, for each country, the structure of the electrical system, the projections of the electrical demand up to the year 2010, and the national policies on primary energy utilization. The fuel cell accessible market has been estimated on the basis of technical and economic evaluations and of the positive and negative factors that can influence penetration in each EEC country. One of the principal purposes of this study is to provide a basis for an European development programme on fuel cells for power stations.

11507 (EUR—10595-EN, pp 54-70) **PAFC R and D carried out in Italy and planned activities.** Ascoli, A. (Centro Informazioni Studi Esperienze, Milan, Italy). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

Work on phosphoric acid fuel cell and stack research and development and demonstration is performed in Italy in essentially three places: CISE S.p.A., Segrate (Milano), Ansaldo Componenti, Genova, and Institute CNR/ITAE, Messina. Fostering and nationwide coordination of these and further activities have been proposed in the 'Volta Project', a preliminary feasibility study prepared for ENEA by a team of specialists of the above mentioned and other interested parties in Italy. State of the art and proposed planning will be shortly reviewed in this paper.

11508 (EUR—10595-EN, pp 71-78) **Development of phosphoric acid fuel cells.** Boehm, H.; Fleischmann, R. (AEG-Telefunken Anlagentechnik, Frankfurt am Main, Germany, F.R. Forschungsinstitut). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The development of phosphoric acid fuel cells in Germany operating under crude gas and air is described. Catalysts, electrode structure and battery construction are discussed. Further activities on fuel cells are proposed.

11509 (EUR—10595-EN, pp 79-96) **Market and system studies for molten carbonate fuel cells.** Derks, R. (HASKONING, Royal Dutch Consulting Engineers and Architects, Nijmegen, Netherlands). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The purpose of the present study is to describe the potential of the molten carbonate fuel cell (MCFC) on the following segments of the Dutch and European Community (EC) Markets: - industrial cogeneration - public electricity production - district heating. The system studies covered the technology issues and provided the financial data required for the cost comparison with alternative systems. These studies were subcontracted to Fluor Nederland and Kinetics Technology International (KTI). Fluor was commissioned to perform system studies for four different configurations of MCFC-Generators based on internal reforming (sizes 0.5 MWdc, 2.0 MWdc and 20 MWdc - 2 configurations). The Fluor studies were based on standard cases and not optimized for a specific application. The KTI study was a case study to compare a 3.25 MWe MCFC plant with external reforming (ER-MCFC) with an existing gas turbine cogeneration facility. The fuel being used in both studies is Groningen gas. Parallel to the system studies the market study was carried out, defining the adressable market for MCFC based on MCFC characteristics and industrial cogeneration requirements. The cost comparison between the MCFC and competing systems resulted in insight in the economic position of the MCFC under various conditions. Matching the adressable market (the technical market potential) with the economics, the market estimation could be established.

11510 (EUR—10595-EN, pp 97-105) **Work carried out on MCFC in Italy and planned activities.** Vellone, R. (ENEA, Rome, Italy). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The work gives a short overview of the Italian activities with molten carbonate fuel cells.

11511 (EUR—10595-EN, pp 106-132) **Molten carbonate fuel cell: Overview and technical problems.** Selman, J.R. (Illinois Inst. of Tech., Chicago, USA. Dept. of Chemical Engineering). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

This paper describes the present state-of-the-art in the development of molten carbonate fuel cells in the U.S.

11512 (EUR—10595-EN, pp 133-142) **Direct oxidation fuel cells.** Manoharan, R.; Hamnett, A.; Goodenough, J.B. (Oxford Univ., UK. Inorganic Chemistry Lab.). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

Direct-oxidation fuel cells utilizing hydrocarbon fuels require the use of an acidic electrolyte. Active forms of carbon suitable for electrode substrates have been prepared, and they are shown to be stable in acidic as well as alkaline electrolytes under practical load conditions. Surface-treated Vulcan XC-72 carbon loaded with 7 per cent by weight platinum have been loaded in 2.5 M sulfuric acid with current densities of 1.1 A cm/sup -2/ intermittently and 900 mA cm/sup -2/ for extended periods without serious degradation. No evidence of hydrogen-peroxide generation was detected under these conditions. Alternative air-electrode catalysts and interfacing with solid electrolytes have yet to be explored. A direct methanol-air fuel cell is a prime target for electric vehicles. The carbon air electrodes have been shown to be stable in the presence of methanol and to exhibit little decrease in performance. Testing of a platinum-loaded carbon electrode for methanol oxidation has given surprisingly encouraging results, and the exploration of alternative methanol-electrode catalysts has already led to improved performance.

11513 (EUR—10595-EN, pp 152-161) **Solid state fuel cells with proton conducting electrolytes.** Jensen, J. (Odense Univ., Denmark. Energy Research Lab.). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The following activities in Denmark concerning solid proton fuel cells are adressed: a) R and D state of the art, b) R and D problem areas, and future R and D requirements, and c) market evaluation.

11514 (EUR—10595-EN, pp 170-184) **Integration of fuel processors and molten carbonate fuel cells.** Blomen, L.J.M.J.; Konings, A.J.A. (Kinetics Technology International B.V., Zoetermeer, Netherlands). 1986. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities. (CONF-8510381—).

From Fuel cell workshop; Noordwijkerhout, Netherlands (7 Oct 1985).

Energy.

The presented data are based on a more extensive study which was prepared for Haskoning, Royal Dutch Consulting Engineers and Architects, Nijmegen, Netherlands, with financial support of PEO (Stichting Projektbeheerbureau Energie Onderzoek), Utrecht, Netherlands. This paper centers upon some options for integration of fuel processors with molten carbonate fuel cell stacks. The economics of an example system of 3.25 MW electric power are included, and an economic comparison with a gas turbine-cogeneration plant of similar magnitude. As a main result it turns out that a 3.25 MW integration molten carbonate fuel cell system is of commercial interest under certain assumptions about the market environment in technical feasibility. The selected system consists of a very simple basic flowsheet, fully integrating a high pressure molten carbonate fuel cell system with a pressurized reformer, in which both the reactive side and fuel (burner) side are at about the same pressure. The example plant producing 3250 kW nett AC power, has an electrical efficiency of 52% (based on the lower heating value LHV) of the natural gas fuel. The fuel cell itself has 64.2% efficiency, which means that the fuel processor (due to complete process integration) has an MCFC fuel generating efficiency of more than 100%, which is understandable from the chemistry of

the reforming process. The economical comparison of the molten carbonate fuel cell system of this size with a gas turbine/cogeneration plant pointed out, that at least under the prevailing site conditions of this case study, the simple pay-out time of the MCFC is better if site conditions require an electric power to heat ratio larger than approx. 1.5. Furthermore, if a very large amount of steam production is required, the simple pay-out times of both MCFC and gas turbine technology are about equal, and secondary aspects might be decisive for selection.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

REFER ALSO TO CITATION(S) 11073, 11074, 11077, 11078, 11078, 11419, 11424, 11424, 11425

11515 (AD-A—173399/7/XAB) Fan electricity consumption for variable-air-volume systems. Final report. Spitler, J.D.; Hittle, D.C. (Illinois Univ., Urbana (USA)). Sep 1986. 99p. NTIS, PC A05/MF A01.

This report documents the results of a study conducted to quantify potential energy savings provided by different flow-modulation methods and fan-control strategies. Results showed that variable-air-volume(VAV) systems have substantial amounts of energy in buildings with large internal loads and considered to be core-dominated. Trends noted were shifting of fractional flows downward for warmer climates and envelope-dominated buildings. Thus, the greatest savings for VAV systems occur in envelope-dominated buildings in cooler climates. The economics decision to install frequency converters or inlet vanes should be based on individual building and climate characteristics. However, noise levels and maintenance factors should also be considered.

11516 (BFR-R—22-1986) Heat from the air used to ventilate drains. Practical tests. Karlsson, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 40p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750624.

The present drainage system contains a total available quantity of heat of the order of 30 TWh per year. Owing to the types and composition of the impurities, it has up to now been difficult to recover in an economically justifiable manner a significant proportion of this heat. A new and unconventional method is now available which recovers heat from drains in a very simple way without coming into direct contact with polluted water. The method is based on the existing drains being used as heat exchangers; a controlled air flow is passed through the drains, and this takes up heat from the effluent and from the surrounding ground. In order to find whether the theoretical calculation and assumptions accord with actual conditions, practical tests have been carried out. The results of these tests are set out in this report. The practical tests have shown that in blocks of flats the energy that can be recovered is about 0.8 kW/flat. In private dwellinghouses the corresponding figure is 1.4-2.0 kW per dwelling. The above implies that, in the Swedish domestic housing stock as a whole, the total recovery potential is 3.5-4.5 TWh per year for blocks of flats and 7.5-10 TWh per year for private dwellinghouses.The potential due to ventilation extract air, which is about twice as large as the potential due to the drainage ventilation air, must be added to the above. A total of ca 25 TWh/year can be obtained by this method. The practical tests further show that it is possible by this method to supply 80-90% of the energy requirements of a dwelling.

11517 (DOE/CE/23858—T2) Mass flow and temperature measurements in the flue of a woodburning appliance. Bell, R.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Feb 1985. Contract AS05-83CE23858. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87002776.

This study investigates several possible errors in flue loss methods used to measure the efficiency of woodstoves. Possible errors from using an unshielded thermocouple in the centerline of the stack for measuring the sensible energy loss were investigated. A wet-basis CO tracer, a pitot array, and a scaled-based technique were used to simultaneously measure the flue gas flow rate. A wet-basis CO tracer measurement technique for measuring flow rates in wood stove flues is described. The results of this study imply that appliances with high sensible energy losses (around 50% of the total input energy) should use a fine-gage thermocouple array to measure the stack temperature. Agreement within 10% was usually observed between the pitot array and the Co tracer. For unknown reasons, poor agreement (i.e., flows differ by 15% or more) was observed between these two methods following an abrupt change in the flow conditions. The scalebased method was hampered by noisy scale readings which prevented an accurate burn rate measurement.

11518 (DTH-LV—171) Modelling of thermal processes in indoor icerinks. Korsgaard, V.; Forowicz, A. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1986. 42p. Danmark Tekniske Hoejskole. Themarmal Insulation Lab., DK-2800 Lyngby, Denmark.

Heat transfer by radiation between ceiling and ice and high humidity of air in indoor icerinks very often cause heavy condensation on the ceiling or roof construction, which has some bad effects. To check how often condensation will occur and possible ways of preventing condensation, a simple computer model of the thermal processes taking place in an indoor icerink was eleborated. The assumptions being made concerning the model system geometry as well as the mathematical problem formulation are described. Next, the mathematical model of the problem being considered, the method of solution and the short description of the simulation program are presented. The report shows further the results obtained from several executions of the program using different data regarding changes in the model itself as well as the influence of different ventilation rates, heat input by radiation and convection etc. These results have allowed for general comparison between four cases, i.e. between the model icerink with a ceiling made from ordinary building material, with a bright aluminium foil glued to the ceiling surface and with a suspended shield of corrugated bright aluminium plates installed below the roof construction, which surface facing the roof is unpainted or painted to increase its absorptivity.

11519 (EPRI-EM—4908) Heat pump experiments using crawl spaces as ground-to-air heat exchangers: Final report. Nicol, J.L.; Carbato, J.J.; Tomlinson, J.J. (Oak Ridge National Lab., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. Contract AC05-84OR21400. 94p. NTIS, PC A05/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87004108.

Experiments have been performed during the winter of 1983 to 1984 with three identical unoccupied houses equipped with heat pumps installed in three different configurations: conventional, single pass crawl space assisted and total recycle crawl space assisted. Analysis of the data obtained shows that the crawl space air is warmed by the ground under the crawl space and also by heat leaked from the house floor and heat ducts. The performance of the heat pumps in the crawl space assisted configurations increased significantly. The heating loads of the houses also increased, largely offsetting the heat pump performance gains. An experimentally-verified model of the crawl space configurations based on DOE-2.1B was used to simulate seasonal system performance in three locations under a variety of operating strategies and ranges. Overall, no significant savings were realized for crawl space-assisted configurations. Cold climates were found conducive to efficient crawl space utilization. Seasonal savings of 3% were found for the total recycle system in Madison. Both crawl space systems in milder climates showed negligible or negative benefits. A principal crawl space-assisted system attribute was found to be a significant reduction in peak electrical demand (25 to 30) percent from reduced heat pump defrost operation coincident with backup resistance heating.

11520 (EUR—9848) Insulation materials for buildings, with good fire resistance, based on novolaque type phenolic resins in the form of reinforced foams. (Commission of the European Communities, Luxembourg). 1985. 92p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

This study has perfected new phenolic foams with improved properties and a continuous method for their manufacture. The most important results are: obtaining low density foams of around 40 kg.m^3, in the form of sheets 0.30 m wide by 3 m long - perfecting a manufacturing method using heating by dielectric loss. The main modification in the composition of the new composite material is the use of a new reinforcement (a layer of polyethyleneterephtalate, instead of glass fibre). The production process has permitted continuous blocks of foam to be produced, 30 cm wide and 3 cm thick, with a mass of 40 kg. m^3. These materials show better resistance to fire and ageing at high temperature when compared with other materials of the same type currently available.

11521 **(EUR—9916) Systematic construction and development of a low-cost solution pump for absorption heat pumps.** Schrader, K.H. (Commission of the European Communities, Luxembourg). 1985. 37p. (In German). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

Marketable, suitable solution pumps for absorption heat pumps are only expensive piston-membrane-pumps. Marketable alternative pumps are problematical in regard to material-compatibility of the well-known synthetic materials. Gear pumps are the best in output capacity. A gear pump of a hydraulic pump-manufacturing company shows the best results in quiet running, volume and volumetric efficiency. In cooperating with this and another company as a specialised electro-motor manufacturer this project was finished. A hermetic split internal gear pump with controllable electromotor has been realised. The result of the development is a full hermetical medium-lubricated system with a 3-turned switchable electrically driven canned motor gear pump. The examinations of function and erosion which were carried out brought forth positive results and confirm a successful project finish.

11522 (GB—45, pp 112-139) **Air-to-air energy recovery in building services and general industrial applications - a survey.** Hillyer, C.R.E. (Thermal Technology Ltd., Trowbridge, GB). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

The majority of the demand for air to air energy recovery in building services is now met by standard production units sized to handle given ranges of volume flow rate. This also applies to a significant proportion of the demand for general industrial use. The main types of equipment in use are rotary regenerators (thermal wheels), plate recuperators, tube recuperators, heat pipes and run-around coils. The trends in design; how each type has become best used, in practice; and the salient features of good system design, based on operational experience are summarised and the use of heat pumps is also included.

11523 **(KTM/E-D—100) Energy conscious plan for a residential area.** Jaervinen, S.; Lappalainen, M. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 73p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750650.

The purpose of this project is to increase available knowledge to achieve energy conservation through physical planning. In the first stage of the project various factors, which have particular influence on the energy consumption and economy in a residential area, have been studied. In the second stage of the project different kind of possibilities to create wintergardens and classed-in courts between houses have been studied. Two energy conscious plans have been drawn up; a conventinal energy consious plan and a "winter-town plan" for a selected area near Helsinki. Energy conscious plan gives savings of 10% and "wintertown plan" gives savings of 20-30% in energy consumption of the area compared with a conventional plan drawn up for the area.

11524 **(LBL—17376) Determining the U-value of a wall from field measurements of heat flux and surface temperatures.** Modera, M.P.; Sherman, M.H.; Sonderegger, R.C. (Lawrence Berkeley Lab., CA (USA)). May 1986. Contract AC03-76SF00098. 28p. (CONF-8609208—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002576.

From ASTM workshop on heat flow sensors; Philadelphia, PA, USA (19 Sep 1986).

Thermal conductances (U-values) and thermal resistances (R-values) are discussed throughout the literature as the appropriate parameters for characterizing heat transfer through walls. Because the quoted numbers are usually determined from the handbook values of material properties, they have several drawbacks: (1) they do not take into account degradation effects, (2) they ignore construction irregularities, and (3) they do not take into account multidimensional heat flow. This paper examines the use of field measurements of heat flow and surface temperatures to determine the U-values of walls. The effects of thermal mass on measurements of wall U-values are described in detail, using two data interpretation techniques to estimate the U-values of insulated and uninsulated cavity walls, with and without brick facing. The errors in U-value estimation are determined by comparison with an analytical model of wall thermal performance. For each wall, the error in the U-value determination is plotted as a function of test length for several typical weather conditions. For walls with low thermal mass, such as an fiberglass-insulated cavity wall, it appears that, under favorable test conditions, a 6-hour measurement is adequate to measure the U-value within about 10% uncertainty. For masonary walls, the measurement time required is considerably longer than 6 hours. It is shown that for masonry walls, and in general, the optimal measurement time is a multiple of 24 hours due to the effects of diurnal weather fluctuations.

11525 **(LBL—22372) Design options for energy efficiency improvement of residential appliances.** Turiel, I. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 93p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87003627.

This report presents information needed for the Department of Energy (DOE) appliance standards evaluation effort. The appliances discussed are refrigerator/freezers, freezers, dishwashers, clothes dryers, water heaters, room air conditioners, home heating equipment, television sets, kitchen ranges and ovens, clothes washers, humidifiers and dehumidifiers, central air conditioners (including heat pmps), and furnaces. In the original standards analysis, completed in the early 1980's, DOE segregated the basic models of each product type into separate classes to which different energy efficiency standards would apply. As mandated by the National Energy Conservation Act, the classes were differentiated by type of energy used, and capacity or performance-related features which provided utility to the consumer and affected efficiency. The purpose of this report is to identify the changes that have taken place in the products since the early 1980's, suggest possible revisions to product classes, and update the selection of design options for energy efficiency improvement. Product classes are recommended for each of these 13 product types. Design options to improve energy efficiency are described for each of the product types. Options used in foreign products and in the prototype stage of development are included.

11526 **(NP—7750591) Comparison between the conventional and the inverted additional insulation of the flat roofs. 2 Ed. .** Christensen, G.; Prebensen, K.; Vesterloekke, M. (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark)). Feb 1986. 84p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750591.

A considerable percentage of all roofs in Denmark are flat roofs covered with roofing felt and as all other types of roof these flat roofs require periodic maintenance. In the conventional method of applying external additional insulation to flat roofs the insulating material is laid on the existing roofing felt, which then functions as vapour barrier, and then simply covered with new layers of roofing felt (the conventional roof). With the inverted roof the method of application is, as the name implies, vice versa. Here the insulation is laid on top of the existing roofing felt which, perhaps having required repair, now functions both as vapour barrier and as watertight membrane. As there is only limited experience with inverted roofs under Danish climatic conditions, it was found essential that a comparison be made between the conventional method of applying extra insulation, the conventional roof, and additional insulation applied in the form of the inverted roof. During the experiments no substantial differences were found between thermal resistance in the

conventional roofs and the inverted roofs without joints. On the basis of the tests carried out it is concluded that the inverted roof is considered suitable for Danish climatic conditions. However, calculations of thermal resistance for the inverted roof must take into consideration the reduced thermal resistance near the joints.

11527 **(NP—7750595) Energy signature. Phase 2. Estimation, budgeting, and applications.** (Birch og Krogboe Raadgivende Ingenioerkontor, Virum (Denmark)). Aug 1986. 59p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750595.

Energy signature is a graphical representation of the energy consumption within a building. The energy consumption is represented as a curve dependent on the outside temperature. When the heating season begins, the energy consumption will rise with falling outdoor temperature. Outside the normal heating season, energy usage is independent of the temperature outdoors and the consumption is mainly due to domestic hot water usage and to some extent low load losses. These are often referred to as basic energy consumption. Energy signature can be used as an effective tool in energy management: Energy management is a cyclic chain of events that is developed on the same principles as a book-keeping system: Auditing, budgeting and monitoring. In Phase 1 of the project, the energy signature was estimated solely on the basis of outside temperature. This gave rise to a large deviation in the measured values and therefore a correspondingly uncertain estimate of the energy signature. To overcome this, a number of models used to estimate energy signature are investigated. Besides outdoor temperature, these models take into consideration wind velocity and solar gain. A comparison of the budgeted and estimated energy signature is shown for three buildings from the Central Hospital in Hilleroed. As shown in this report energy signature is an extremely useful tool for energy managements main activities: Budgeting, monitoring and auditing. Furthermore, if an Energy Management Automated Control System is installed in a building, then energy signature's many advantages can be utilized to their full extent.

11528 **(NP—7750629) Reduction of oil consumption at governmental authorities 1990. Specification of plans. Analysis of possibilities.** Enqvist, J.; Karlsson, T. (Statens Energiverk, Stockholm (Sweden)). 1984. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750629.

In 1983, the Swedish Government gave real estate authorities instructions to work out plans for reduction of the oil consumption to the year 1990. The results now presented show that the premises to cut the oil consumption are good. In most cases it means more use of district heating and electricity. (K.A.E.).

11529 **(ORNL/CON—193) Horizontal ground-coil heat exchanger theoretical and experimental analysis.** Mei, V.C. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87004051.

Ground-coupled heat pump systems have long been recognized for their high potential for energy conservation. However, the design of the ground-coil heat exchanger is still largely based on line-source theory, which was developed for heat pump ground-coil application back in the 1940s. Although this theory is easy to use, many important factors in ground-coil design have to be excluded because of the limitations of the theory. New models to better predict ground-coil performance are needed. Based on energy balance, three ground-coil models were developed: One incorporates a radially symmetrical temperature profile and a soil freezing effect around the coil; one includes a three-dimensional ground temperature distribution caused by heat transfer between the ground surface and ambient air; and one contains ground heat transfer and thermal interference effects. All three models have been validated with the field experimental data provided by Brookhaven National Laboratory and by The University of Tennessee. The maximum error in calculated energy exchange between coil and gound is $<16\%$, on the conservative side, compared with the measured values. One section of this report includes a comparison of: (1) a line-source theory model; (2) a modified line-source theory model; and (3) one of the ORNL models. All three models were used to simulate the same field experiment. The results indicated that the ORNL model is much better than the other two. Finally, some possible future work involving mass transfer induced by the soil temperature gradient is discussed. The computer codes, which are easy to use, are included in the appendices, along with sample calculations. These codes can be used for ground-coil design purposes or for checking the coil design with other methods.

11530 **(ORNL/CON—216) Residential wood-use in the Pacific Northwest, 1979-1985.** Tonn, B.; White, D. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 89p. NTIS, PC A05/MF A01. File Number DE87004021.

This report analyzes wood use for residential space heating in the Pacific Northwest. Issues addressed are the levels, trends, and determinants of wood use, as well as relationships of wood use to conservation program planning and evaluation. Six data sets were used in the analysis. Three contain data on representative samples of housing units in the Bonneville Power Administration's (BPA) service area. These data bases were collected starting in 1979 and extending to 1985. The other three are products of Oak Ridge National Laboratory evaluations of BPA's residential conservation programs' energy savings. The former data sets are used to provide insights into the extent and trends of wood use, whereas the latter data sets are used mostly to relate wood use to problems in accounting for program energy savings.

11531 **(ORNL/CON—222) Building Foundations Research agenda.** Christian, J. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87004037.

A recently completed assessment of energy savings potential of thermally upgrading building foundations found that 0.5 quads/year (0.523×10^{18} J/year) of energy could be saved by broad application of foundation wall and slab edge insulation in the United States. This agenda outlines the research that could lead to the attainment of this savings. The research consists of: techniques for accurate soil characterization to select inputs for calculating foundation heat loss, a validated foundation heat and mass transfer algorithm coupled with a whole-building simulation model, an experimental data base from one or more well-characterized test sites, and design tools. The Building Foundations Research Program fulfills the short-term needs of delivering available information on energy-efficient foundation construction practices to lead builders and also fulfills the longer term needs of substantiating an array of design tools based on well-characterized test site data and validated simulation models. The primary research product focus is a set of foundation handbooks targeted at builders and designers. The major appeal of this approach is that it provides a traceable path through research projects coupled to hard field measurements - yet the builders do not have to wait for the time-consuming stages of field and laboratory data collection, research benchmark model development, model validation, nor systems analysis. The handbooks are updated as research findings develop.

11532 **(PNL—6080) Review of existing residential energy efficiency certification and rating programs.** Hendrickson, P.L. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 164p. NTIS, PC A08/MF A01. File Number DE87004045.

This report was prepared for the Office of Buildings and Community Systems, US Department of Energy (DOE). The principal objective of the report is to present information on existing Home Energy Rating Systems (HERS) and their features. Much of the information in this report updates a 1982 report (PNL-4359), also prepared by the Pacific Northwest Laboratory (PNL) for DOE. Secondary objectives of the report are to qualitatively examine the benefits and costs of HERS programs, review survey results on the attitudes of various user groups toward the programs, and discuss selected design and implementation issues.

11533 **(SBI-R—172) Comparison between high-temperature and low-temperature radiator systems. Results from a test project.** Christiansen, J.; Kjellerup, M.; Pedersen, T. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1986. 61p. (In Danish). Statens Byggeforskningsinsitut, P.O. Box 119, DK-2970 Hoersholm, Denmark. Price: Dkr. 90.00.

A comparison is made between radiator systems designed for low-temperature operation (55 deg C main supply temperature) and high-temperature operation (90 deg C main supply temperature). The project was carried out as a full scale test in a newly erected apartment house. Two test apartments were analysed, one with low-temperature heating and one with high-temperature heating. The conclusion of the test is: the energy consumption in low-temperature heated apartments does not differ from that in corresponding apartments with high-temperature heating. Apart from areas close to the radiators, the comfort level with the two forms of heating is the same at the same temperature. Low-temperature heating increases the cost of the radiator systems by 15 - 18% and the cost of the entire building by 0.4%. 8 refs.

11534 **(SBI-R—173) Production and distribution of hot utility water in a low-temperature radiator system. Results from a test project.** Christiansen, J.; Pedersen, T.; Ovesen, K. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1986. 38p. (In Danish). Statens Byggeforskningsinstitut, P.O. Box 119, DK-2970 Hoersholm, Denmark. Price: DKr. 74.75.

It is possible, by quite simple means, to design a utility water system in which the hot water is produced using low-temperature district heating water (55 deg C). The only major difference is that the heat exchanger must be larger, while the pipe system for the hot utility water can be designed in the same way as in the case of high-temperature district heat. When the heat source has as low a main supply temperature as 55 deg C, a considerably larger heat surface than normal is required. Compared with a heat source with a temperature of 90 deg C, the heat face must be 2.5 to 3.5 times as large for low-temperature operation. The tank itself can be of the usual size if this leaves room for the approx. 3 times larger heat exchanger. Measurements were carried out in three different periods in 1984. The main supply temperature on the primary side averaged 54 deg C, the temperature of the utility water 46 deg C, with a minimum of 42 deg C, and the return temperature on the primary side 27 deg C. The measurements also showed that the water consumption was not much higher than in periods when a higher temperature was used for the utility water. The design rules normally applied for heat exchangers and tanks, supplemented by a temperature correction, seem to give a satisfactory result, but it should be noted that with the temperature used here, there is only a narrow margin for error in design, construction and operation.

11535 **(SBI-R—174) Energy consumption for heating of buildings. Unit consumption for energy planning.** Budde, J.; Pedersen, D.O. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1986. 71p. (In Danish). Statens Byggeforskningsinstitut, P.O. Box 119, DK-2970 Hoersholm, Denmark. Price: DKK. 99,75.

The objective of this report is to throw some light on the net energy consumption for heating and hot utility water for various types of buildings, measured in GJ/m/sup 2/, the socalled unit consumption. In the Energy Planning of the Ministry of Energy, the unit consumption is applied to calculation of the energy consumption for heating and hot utility water throughout the country of Denmark. The reported figures for the unit consumption must be considered to be the average of the years 1980-1982, corrected for graduation days. The unit consumption indicated is a net consumption, i.e. corrected for loss of heat, if any, within the heating system. For dwellings, the unit consumption for farm houses amounts to 0.640 GJ/m/sup 2/ per year. This also applies to the group of "Other multi-family houses" comprising a.o. dormitories and dwellings in connection with industrial and commercial buildings. Multi-storey housing has a unit consumption of 0.610 GJ/m/sup 2/, detached houses 0.514 GJ/m/sup 2/, and for semi-detached houses the unit consumption is the lowest one, 0.478 GJ/m/sup 2/ per year. Among other types of buildings, hospitals show the highest unit consumption, 0.755 GJ/m/sup 2/. In service buildings and buildings for production purposes a unit consumption of 0.534 up to 0.683 GJ/m/sup 2/ could be measured. The study shows that dwellings heated through central heating with oil or oil heaters indicate the highest unit consumption of all types of dwellings. Dwellings heated through electric furnaces or with solid fuel show a considerably lower unit consumption. For dwellings heated through district heating, the unit consumption is halfway between. (LN).

11536 **(STEV-FBA—86-9) Flue gas condensation when firing wood in single-family houses.** Rudling, L. (Statens Energiverk, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Apr 1986. 74p. (In Swedish). (STUDSVIK-EP—86-15). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750631.

Various operating problems are reported and improvement of efficiency when applying flue gas condensation to burners for one-family houses is discussed. The cost of the equipment will have a pay-off time of 4 to 4 years and the degree of efficiency is calculated to be 95% (H/sub/(cal)), which means fuel savings by 33 to 43%. (G.B.).

11537 **(TKK-KO/LVI—B8) Factors affecting the control of an air conditioning apparatus.** Rantama, I.; Siren, K. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 131p. (In Finnish). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750655.

The aim of this research was to find out factors which have an effect on the controlability of the ventilation system, and demands set for the control. Also, changes taking place in the airflow during the control of airmixing were examined. The results of the research are based on theoretical calculations and computer simulations. The effect of control on thermodynamic behavior of the room and further on to comfort was examined. In normal cases, according to the ASHRAE standard, fluctuation of the supply air temperature does not create any problems with comfort. A netmodel of the ventilation system was developed with purpose of examining changes in the airflow during the control of airmixing. A model of several components of a ventilation system was developed for the netmodel. The calculations show that the total airflow can change notably with different airmixing ratios. The effect of different factors on the controlability of heating and mixing processes was examined by looking for the critical gain of the system, where at the hole system starts to tremble with constant amplitude. The most remarkable factors which reduce the controlability were death time sensor speed and in heating process the temperature difference between primary supply water and intake water of the coil. In the end, the demands set for the result of the control and the equipment and any methods for testing were examined. However, no limit values for the demands have been brought up.

11538 **(TKK-KO/LVI—B9) Mathematical modelling and control of an air conditioning apparatus.** Suhonen, M. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 109p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750654.

On the present work the dynamic behaviour of the air conditioning apparatus has been examined. The work deals with the most common components used in today's air conditioning apparatus. The study of the components of the air conditioning systems has been made with the support of the literature and using simple mathematical models with have been hade in this work to describe the function of the apparatus. These models have been programmed into a computer with which the simulation of the system has been done. The time constant of the thermometer and the temperatures of the air flow were observed to be the most significant factors which have effect on the behaviour of the process when mixing two flows of air. When the flow of the air was heated with a radiator, the most significant factors were again the magnitude of the air flow and the time constant of the thermometer. In humidification they were the time constant of the process and the temperature of the air flow.

11539 (TKK-KO/LVI—C9) Indoor air quality of a building and the requirement adapted ventilation system. Kuusela, L.; Pekkanen, J.; Suomi, U. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1984. 100p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750656.

This report consists of a study of the measuring devices available for CO/sub 2/- and CO-concentration measurements and particle and odor measurements and their adaptability to control ventilation in different of buildings. Additionally, the technical feasibility of the system in different air conditioning systems and the economy of the system was studied. CO/sub 2/ was found to be a reliable control variable in spaces where smoking is not allowed. In spaces where smoking is allowed, the variation in the particle concentration and the variation in the output of the air quality sensor were better indicators of the air quality, but these control variables were not as reliable as is required from a measuring element connected to control the outdoor air flow to a space. To become more popular, the air quality controlled ventilation system needs more reliable and inexpensive measuring devices than are now available on the market. The requirement adapted ventilation system can be connected to almost all air conditioning systems. It is easiest to apply when outdoor airflow can be adjusted by altering the recirculation air rate. With this system savings of about 20-30% can be achieved in air conditioning energy consumption. The system is calculated to pay itself back in 1 to 4 years, depending on the measuring device used. A computer program based on the general mass balance equation was developed as part of this work. With the program, calculations of the diffusion and dilution of gaseous contaminants in several rooms as a function of time can be made.

11540 (TKK-KO/LVI—C15) Indoor air contaminant sources and calculation of emission rates. Vaeisaenen, H. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1985. 109p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750657.

This study comprises the current knowledge about indoor air contaminant sources, emission rates and active and passive air-cleaning. A summary of control methods and strategies for sources of indoor air contaminants is also given. A multi-comparatment simulation model was developed to calculate the theoretical diffusion and dilution of gaseous contaminants in rooms with different air-conditioning systems. The major contaminants presented in this raport are CO, CO/sub 2/, NO, NO/sub 2/, NO/sub x/. O/sub 3/, radon, formaldehyde, organic vapours and gases and particles. The sources are classified as following: outdoor air, human being, building materials, consumer products, technical equipment, combustion processes. Emission rates given in this raport area mainly min., max. and mean values, because emissions often have great natural variances. The effect of external factors to emission rates is given to formaldehyde release from chipboard and to outdoor air particles and SO/sub 2/-concentrations. To date (1984), little information has been published on the generation rate of contaminants of indoor origin. Moreover, it is often difficult to draw conclusions from different research raports because of insufficient background information. Although all the values in this raport are not statistically totally reliable, we can use these values when estimating contaminant concentrations in different areas.

11541 (TKK-KO/LVI—C18) Measurement of the air exchange efficiency in different ventilation systems. Roos, R.; Majanen, A.; Helenius, T. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1985. 167p. (In Finnish). NTIS (US Sales Only), PC A08/MF A01. File Number DE87750658.

The aim of this study was to clear up the aspects that appear while measuring the air exchange efficiency in practice. In addition intention was to obtain some knowledge of the air exchange efficiency of various air exchange systems. Air exchange effectiveness was studied only in the air exchange efficiency point of view. The measurements were done in a laboratory and in actual buildings. In a laboratory three different air distribution systems were analyzed. Field measurements were done in dwellings and officebuildings, where six various air distribution systems were analyzed. On the basis of the laboratory tests conncections between various efficiency indexes were developed. One important result was to realize that the mean-age of the air in the occupation zone can be determined of the value of the air exchange efficiency. Also it was noticed that the air exchange efficiency can be determined by using only tracer gas method. Local mean-ages of the air can be calculated when the starting of the decay is inhomogenious by using a method that was developed. In field measurements the differences in the local mean-ages inside the same building were small. The air exchange efficiency was in dwellings within the range of 0.40 - 0.50 and in office buildings 0.45 - 0.60.

11542 (TVA/OP/CEM—86/29) The TVA [Tennessee Valley Authority] heat pump financial package is worth considering. (Tennessee Valley Authority, Chattanooga (USA). Div. of Conservation and Energy Management). 1986. 15p. NTIS MF A01. File Number DE87900329.

A financial aid package is presented by TVA for apartment building owners who are considering heating pumps. (BCS)

11543 (VTT-TIED—583) Profitability of energy saving measures in existing residential buildings. Rejstroem, L.-O.; Blomberg, U. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 118p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750649.

The profitability of energy saving measures was studied in existing residential buildings. The most common energy saving measures in detached houses were additional roof insulation, installation of thermostatic radiator valves and installation of a third window pane. In row houses installation of thermostatic radiator valves was the most common measure. In apartment houses installation of thermostatic radiator valves and connection to district heating were the most common measures. In the study energy consumption data was also collected from residential buildings where no energy saving measures had been undertaken. On the basis of this reference data the energy consumption in the buildings, where measures had been taken, would have decreased 2% per year in any case due to changed energy consumption habits. Considering this, the energy consumption has decreased 14.0% in apartment houses, 13.9% in row houses and 10.2% in detached houses, due to energy saving measures. The profitability of the measures was calculated on the basis of the energy savings and the total costs of the measures given by the respondents. The average internal rate of return of the investment was 30.8% in apartment houses, 27.5% in row houses and 8.1% in detached houses. The average payback time was 3.0 years in apartment houses, 3.6 years in row houses and 9.7 years in detached houses. The most profitable measures were connection to district heating, installation of thermostatic radiator valves and installation of a third window pane. The only clearly unprofitable method was additional insulation of the walls.

11544 A comparative economic evaluation of industrial heat pumps. Bliem, C.J.; Mills, J.I. (Idaho National Engineering Lab., Idaho Falls, ID 83415). pp 403-409 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

This paper presents the findings of a study on the cost of delivering process heat with state-of-the-art heat pump systems. Sixteen heat pump systems were configured for relative cost comparisons. These systems consisted of electrically driven, prime energy driven, and waste energy driven reverse Rankine cycle heat pumps of the open, semiopen and closed type. In addition, a waste energy driven absorption heat pump was analyzed. A conceptual design of each system was created using off-the-shelf components generally available to engineering firms. The performance of each system was assessed.

11545 **Impact of operation and control strategy on the performance of a thermal energy storage system.** Warren, M.L. (Building Energy Systems Program, Lawrence Berkeley Lab., Berkeley, CA 94720). pp 760-765 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). Contract AC03-76SF00098.

The method of operation and control of a thermal energy storage system will have significant impact on the value of the system to both the customer and the utility. The annual performance of different operating and control strategies for thermal energy storage systems can be compared by simulation analysis. In the paper, simulation of the annual performance of a thermal storage system is based on hourly cooling loads generated with a DOE2 simulation for a typical small office building. The thermal storage system is sized to meet the maximum daily load for the building. The comparable conventional system is sized to meet the typical building peak load. The operation of the thermal storage system is then modeled hour by hour. Results of the simulation analysis show that while chiller priority control achieves the desired peak load reduction, only that part of the cooling load greater than the chiller capacity is shifted to partial-peak or off-peak hours. The chiller runs, charging storage, on through the evening hours. Application of storage priority control shifts a greater portion of the annual cooling from on-peak to partial-peak and off-peak hours. This results in greater cost savings to a utility customer on time-of-day rates.

11546 **Long-run projections of state-level commercial and residential energy use.** McDonald, J.F.; South, D.W. (Argonne National Lab.). pp 592-614 of Proceedings of the seventh annual North American meeting, International Association of Energy Economists. Thompson, W.F.; DeAngelo, D.J. Boulder, CO; Westview Press, Inc. (1985). (CONF-851285—).

From 7. annual North American meeting of the International Association of Energy Economists; Philadelphia, PA, USA (10 Dec 1985).

Forecasts of energy use at the state level and for the long run (1980-2030) are not usually prepared for the residential and commercial sectors by either public or private organizations. In addition, most energy forecasting models of the residential or commercial sectors are not designed to generate such forecasts. This paper describes a modeling system that has these features: the Commercial and Residential Energy Use and Emissions Simulation System, or CRESS. CRESS is a new model that has been under development since mid-1984. A test version of the modeling system is now operating and preliminary results have been generated. These results are being used to validate the system and verify its long-run forecasting capabilities. This paper, which provides the first documentation of the structure, development, and output of CRESS, is both an abbreviated summary of model development and a status report.

3202 Transportation

REFER ALSO TO CITATION(S) 11587

11547 **(AD-A—173531/5/XAB) Economic analysis of vehicle-sharing mode for journey to work by Indonesian office employees. Master's thesis.** Wreksodihardjo. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1986. 76p. NTIS, PC A05/MF A01.

This thesis analyzes the economics of vehicle sharing and the implementation of this mode of transportation for major Indonesian cities. Current vehicle-sharing programs are reviewed, a model is constructed which parameterizes the major elements of the vehicle-sharing decision. The model is validated using historical data. Then the model is used to assess the feasibility of vehicle sharing prodgrams for five areas of Indonesia. The model indicates that such programs are feasible for these areas, and the thesis concludes by examining some important elements in implementing such programs.

11548 **(ERL—86006) Demonstration project with 5 electric vehicles in Odense, Denmark. Final summary report for contract EE/85/80.** Nissen, O.S. (Laboratoriet for Energiforskning, Odense (Denmark)). Apr 1986. 30p. (LFE—86006). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750592.

This project has shown that electric vehicles even with the present battery technology can meet the demands of anexisting public fleet in urban transport. Except for technical problems during the introduction phase and the fact that the number of stand still days was too high during the whole project period, the experiences with the FIAT electric vans can be characterized as satisfactory from the users point of view. Furthermore the introduction of electric vehicles in Odense has shown that electric vehicles in combination with a combined heat and power plant may lead to a substitution of 1 l fuel with 1 kg coal. The main problem with electric vehicles is in fact that the number of these vans is so small. If we had a larger number of these vans there would have been professional organisations like the traditional motor car shops to take care of them. Such organisations may have been able to reduce the number of idleness days to a minimum.

11549 **(ORNL—6309) Oak Ridge National Laboratory MPG and Market Shares Data System: User's manual.** Hu, P.S.; Till, L.E. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87004057.

This user's manual provides documentation on the application programs developed for the Oak Ridge National Laboratory MPG and Market Shares Data System. The system was first conceived in 1979 and was modified in 1982. The data system uses the 1022 Data Base Management System on the Digital Equipment PDP-10 series computer at Oak Ridge National Laboratory. The major purpose of the system is to monitor trends and changes in fuel economies, sales, market shares, and other vehicle characteristics of all new automobiles and light-duty trucks sold in the United States since model year 1976. The manual first describes the data base structure in detail, and then leads users through the application programs one at a time in a step-by-step manner. The organization of this manual allows the users to go directly to the desired program without going through any other program descriptions. Very little 1022 Data Base Management System knowledge is required to run these programs. However, as mentioned in the report, there are a few programs that require some experience with the 1022 Data Base Management System.

11550 **(PB—87-107553/XAB) Warrants for interconnection of isolated traffic signals. Research report, September 1079-August 1986 (Final).** Chang, E.C.; Messer, C.J. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Aug 1986. 77p. (TTI—2-18-80-293). NTIS, PC A05/MF A01.

The project suggests guidelines and procedures to identify when adjacent signalized intersections should be interconnected. Field data from several Texas cities were used to calibrate the TRANSYT-7F and PASSER II computer programs. These programs were used to address the effects of progression changes in travel time and travel volume. Detailed field studies were performed at six (6) intersections.

11551 **(SL—85924) Basic material for auxiliary sails on ships.** Ingham, P. (Skibsteknisk Laboratorium, Lyngby (Denmark)). Dec 1985. 117p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750599.

The purpose of this project is to establish calculation basis for design of auxiliary sails on ships, with regard to sail type, sail effect on ship energy saving and sail effect on ship stability. The project comprehended wind tunnel tests with 3 ship models and 3 different sail arrangements in order to measure wind loads on the ships and sails. Special computer programs have been developed for determination of potential energy savings on the basis of combined sail measuring results wind-statistical data and hydrodynamic data. The investigated sail-types are: the traditional triangular foresail, a rectangualr curved canvas sail on a pivotal mast and a wing profile with constant cross-section geometry of NACA 0015 type known

from the aircraft industry. First results seem to indicate that large trawlers, tanker ships up to 60,000 tdw and dry cargo ships up to 60,000 tdw can achieve substantial energy savings by using auxiliary sail arrangements.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 10760, 10795, 10996, 11430, 11450, 11546

11552 (DOE/CE/40738—T2) High-intensity drying processes impulse drying: Report two. Lavery, H.P. (Institute of Paper Chemistry, Appleton, WI (USA)). Feb 1987. Contract FG02-85CE40738. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87004107.

Impulse drying is under study as an alternative to conventional cylinder drying of paper and paperboard. Work over the past year has found the following: Impulse drying reduces drying energy requirements to as little as 500 Btu per pound of water. The specific energy requirement decreases with increasing initial sheet moisture content. Water removal rates are far greater than attainable with conventional drying. Impulse drying produces substantial increases in density. Impulse drying improves strength properties. The increase in tensile strength and STFI compressive index for recycled fiber and high-yield pulp linerboard is particularly significant. The z-direction density profile produced by impulse drying can offset the decline of certain properties such as opacity and tear strength which would be expected from increases in average density. A pilot roll impulse dryer has been designed and is presently under construction.

11553 (DOE/CS/40380—T1) Energy integrated dairy farm system in New York: Final report. Walker, L.P.; Ludington, D.C.; Merrill, W.G.; Pellerin, R.A.; Reid, W.S.; Space, R.; Space, R. II; White, S.A.; Heisler, M.G.; Farmer, G.S. (Cornell Univ., Ithaca, NY (USA)). Sep 1985. Contract FC07-80CS40380. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003864.

This technical manual was developed from the experiences and results gained from Cornell University's Energy Integrated Dairy System Project (EIDS). Goal of the project was to reduce fossil fuels and fossil fuel-based inputs into an income producing dairy farm by substituting energy efficient processes and practices for energy-intensive ones, and using solar-based energy sources - wind, active solar, and biomass.

11554 (DOE/ER/13488—1) Studies in finite time thermodynamics: Progress report for period April 1, 1986-March 31, 1987. Berry, R.S. (Chicago Univ., IL (USA)). Oct 1986. Contract FG02-86ER13488. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003574.

During the year, we completed our study of light-driven dissipative engines. This work began with the demonstration of requirements for a dissipative system to be a work source and of how certain model systems can meet those requirements. The next step applied the concept to a simple but relatively realistic system in which the working substance has two chemical forms with the same mole number for each, i.e., $A \rightleftharpoons B$, and the heating via light is simplified into a Heaviside step function. The conclusion of the work for the present is the analysis just completed which is based on the real system of the fluorosulfate radical SO_3F and its dimer in an inert carrier as the working fluid.

11555 (DOE/ID/12519—T1) Development of a process to produce chemicals from lignocellulose. Final report. Allen, B.R.; Dawson, W.J.; Jenkins, D.M. (Battelle Columbus Labs., OH (USA)). 26 Jun 1985. Contract AC07-84ID12519. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85017028.

This report is the final report on a research program to investigate the technical and economic feasibility of a conceptual process for the conversion of cellulose and hemicellulose in waste materials to higher value chemicals, such as lactic and acetic acids. The conceptual conversion process was based upon previous studies by Battelle on the conversion of simple sugars to etlhanol via a thermochemical process. This process involves the production of lactic acid as an intermediate.

11556 (DTH-LBM-TR—143) Mixing ratio of fly ash concrete. Hedegaard, S.E. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Bygningsmaterialer). 1985. 67p. (In Danish). Danmarks Tekniske Hoejskole. Lab. for Bygningsmaterialer, DK-2800 Lyngby, Denmark.

In this report the so-called DOE method for concrete production has been developed to include the processing of a concrete containing fly ash. Experimental results are reported showing that the two fundamental relationships between mix production and concrete properties as expressed in 1) Lyse law and 2) Bolomey las, can be expanded to include fly ash concrete. Lyses law may now be expressed as: For given materials the workability of concrete mixes is a function of the free water content and the fly ash content. Bolomey law may now be expressed as: For given materials, curing conditions and curing time the concrete strength is a function of the free water/cement- and water/fly ash ratio exclusively and is independent of the absolute water content, cement and fly ash content. Limits of the modified Lyse law and formulas for the modified Bolomey law are presented in the report. (EG).

11557 (ESC—36) Investment in saving energy costs. An investigation into the deliveries by the Dutch trade and industry. Van Wees, F.G.; Boswinkel, H.H.; Duijves, K.A.; Gerbers, D.; Kruijswijk, B.J.; Van der Veen, J.C. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Oct 1986. 366p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report presents the results of a study to determine the expected share of Dutch domestic firms in the production and delivery of energy saving equipment installed in the Netherlands for the period 1990-2000. Thirteen important energy saving techniques are considered. Based on savings realized in terms of energy and money, and the level of required (additional investment, the profitability of these techniques is calculated. Based on theoretically available market potential and the additional constraints, the total market penetration level is estimated for the period 1990 to 2000. For each technique the share of imports and domestic production is established. In addition to the production of equipment, the contribution of Dutch engineering and installation firms is also taken into account. By means of this procedure it is stipulated that Dutch firms may contribute about 80 percent of the total value (Dfl. 20 billion) of energy saving equipment in the period considered.

11558 (ESC-WR—85-28) The outlook for industrial cogeneration in Western Europe (gas turbines in the early nineties). Boswinkel, H.H.; Koenders, N.J.; Roos, A.L. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). 1985. 13p. (CONF-850961—1). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

From Gas and electricity markets in Europe: prospects and policies; Luxembourg, Luxembourg (23 Sep 1985).

The analysis presented is limited to gas fired combined cycles with back pressure systems and Western Europe is represented by the Federal Republic of Germany, France and The Netherlands. The typical cogeneration plant is assumed to have a capacity of 20 MWe and produces 75 tons of steam per hour. A typical industry, which operates this plant, needs 50 MWe during 6000 hours per year. Compared are two solutions: a natural gas fired industrial boiler producing 75 tons of steam per hour and a claim on the public grid of 50 MW for 6000 hours per year, and a natural gas fired combined cycle producing 75 tons of steam per hour and generating 20 MW, claim on public power: 30 MW. The profits of cogeneration are expressed in a nominal internal rate of return. 9 figs.

11559 (EUR—8859) Improvements of heat exchangers associated with steel slab furnaces. Roth, J.L. (Commission of the European Communities, Luxembourg). 1984. 43p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

A reheating furnace feeding a steel mill consumes 40,000 to 50,000 toe of fuel a year. This can be decreased by improving the efficiency of the heat exchangers which preheat combustion air using the exhaust gases of the furnace (at 1000°C). The aim of the present work is to examine ways in which the existing heat ex-

changers can be improved by simple modifications which have a short pay-back time. The work carried out consists of simulating the heat exchanger with a computer model. This was based on experiments carried out on a 1/5 scale model and on measurements carried out in an industrial plant. Several construction improvements to the current heat exchangers have been identified, consisting of the introduction of metallic pieces which increase heat exchange, e.g. radiative panels increasing the radiative heat flux; and "turbulors", i.e. devices increasing the convective heat flux. Practical solutions are also proposed to avoid the errors of air preheater feed identified during the industrial trials. The proposed actions each lead to yearly energy savings calculated to be approximately 400 toe per furnace and are additive. Investment costs are moderate and give a pay-back period of 6 months.

11560 (EUR—9849) **High-temperature Brayton-cycle industrial heat pump.** Flaux, J.P. (Commission of the European Communities, Luxembourg). 1985. 59p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

The object of this study was the development of a high-temperature Brayton-cycle heat pump. It comprised two phases: the first concerning the study and improvement of the system as a function of the type of process selected after market analysis; the second concerning the establishment of, and experimentation with, the process. The report analyses the technical and economic reasons which led to the premature interruption of the second phase of the study, whereas the first phase had ended with a positive evaluation of the application of Brayton-cycle heat pumps.

11561 (GB—45, pp 18-33) **Shell and tube heat exchangers in the chemical and process industries.** Moore, M.J.C. (Brown, John Engineers and Constructors Ltd., Portsmouth, GB). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

Shell and tube heat exchangers are commonly used in all types of process plant. Many are used simply for the injection or rejection of heat into or out of various parts of the plant. However, they are frequently used to remove unwanted heat from one part of a plant and to re-introduce it into another part. This may be applied locally, where heat from process is re-introduced into the same process or it may be a remote exchange even to the extent of exporting the rejected heat to a different plant on the same complex. For transferring heat in this way the cost of fabrication, installation and maintenance of the exchange equipment must be offset against the savings in operating costs that will result.

11562 (GB—45, pp 35-57) **Economisers for gas fired boilers.** French, C. (Saacke Ltd., Portsmouth, GB). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

The potential savings to be made by the utilisation of a conventional economiser recovering sensible heat from gas fired boilers is considered. The adoption of enhanced heat recovery by the use of condensing economisers and aspects of design are evaluated. The relationship between the thermal and mechanical parameters are vitally important to obtain a cost effective design which will minimise payback period and applicational layouts both for new boilers and as a retrofitted item are examined. Performance data and the effect on economics of operation are also given.

11563 (GB—45, pp 59-76) **Developments in recuperative and regenerative burners for use in high temperature furnaces.** Webb, R.J. (British Gas Corp., Midlands Research Station, Solihull, GB). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

Recuperative burners provide a practical and cost effective means of combustion air preheating and are now widely used in industry and have been successfully applied to many types of furnace and kiln with resultant fuel savings of typically up to 30%. To provide even higher savings a novel regenerative burner system has been jointly developed by British Gas and Hotwork Development Ltd., and this system has been recently introduced into industry. This system is able to recover a very high proportion of the heat in the flue gases leading to fuel savings of up to 60% and is also suitable for some 'dirty' processes, for example aluminium melting, where there is carry over of material from the process with the flue gases.

11564 (GB—45, pp 78-103) **U-know how for heat recovery.** Lamb, B.R. (A.P.V. Co. Ltd., Crawley, UK). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

Heat recovery is many things to many engineers. To understand some of the advantages of heat recovery it is necessary to appreciate the technical improvements in heat transfer equipment and thereafter apply these to particular process conditions. Paraflow plate heat exchangers provide many advantages in processes involving liquid to liquid heat transfer. Improvements in plate design, the efficiency of heat transfer, and their use in field applications is discussed.

11565 (GB—45, pp 104-110) **Government assisted heat recovery studies identify Pound 1.5 M/y energy savings.** Strinivasan, G. (Atkins, W.S. and Partners, Epsom, UK). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

Many industrial companies are making significant savings by installing heat recovery equipment. The Government encourages this with generous financial support for the appraisal and design of such projects through the DTI's Industrial Heat Recovery Scheme. The scheme has already supported studies that have identified a total of over Pound 1.5 million savings per year for an investment of some Pound 2.5 million for new equipment. These figures show that payback periods of less than two years can be achieved on many projects. Making use of Government support, assistance provided, available financial help and case studies are discussed.

11566 (GB—45, pp 141-156) **High temperature waste heat recovery projects within the Energy Efficiency Office's scheme.** Gettings, M. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1986. BLDSC, Boston Spa, Wetherby, Yorks. (CONF-8509340—).

From Waste heat: recovery and utilization symposium; Portsmouth, UK (25 Sep 1985).

The energy lost every year by UK industry as waste heat is equivalent to the burning of about 9 million tonnes of coal (mtce). This heat is lost over a wide range of temperatures but it often is lost in gases above 400°C which constitutes the greatest services of waste in UK industry. Heat losses can be particularly excessive in processes which use fossil fuels either to melt, change the chemical state, reheat or heat treat materials. In these processes combustion products, in the form of gases, are often emitted at high temperatures and can be highly contaminated with particulates and/or noxious vapour. Government schemes are discussed and an example is given.

11567 (KTM/E-D—99) **Utilization of mechanical compression of steam in large-scale industry.** Salin, J.-G.; Jungerstam, B.; Erkomaa, H.; Huhtinen, M.; Eerola, H.; Raiko, M.; Saukkonen, M. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 81p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750659.

Mechanical vapour recompression is one method by which electricity can be substituted for other energy forms in certain industrial processes. Although mechanical vapour recompression has proved to be feasible in many applications, its wider utilization has been obstructed by the lack of information and operational experiences. The purpose of this study was to collect and present information and experiences about the use of vapour recompression e.g.

by measuring existing compression plants. Furthermore, such industrial processes where mechanical vapour recompression can be applied were identified and assessed especially in pulp and paper industry. Following unit operations were studied more carefully: evaporation, distillation, drying and mechanical pulping. In evaporation and distillation plants the prerequisites to apply mechanical vapour recompression are good as the technology is known and already adapted in certain extent. In pulp industry ten evaporation plants were identified in which possibilities to introduce this technology are promising. Drying processes including recompression are still at development stage and they are not expected to become common in near future. Heat recovery systems connected with drying of pulp, paper, fuels such as peat and bark, sugar and fertilizers, are expected to include vapour recompression in the future. In the field of mechanical pulping the vapour recompression is well adapted to be connected to the pressurized groundwood (PGW) method.

11568 **(KTM/E-D—103) Marketing perspectives of automation systems for production and usage of energy in wood processing industry, preliminary study.** Anttila, J.; Haikala, M. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 29p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750661.

This report describes the present level of the automation systems at Finnish pulp and paper mills, market shares of different suppliers and marketing prospects of automation systems during the following five years. The effect of the automation systems on energy consumption has been evaluated by dividing different processes to different classes according to the alternatives of energy saving. By using the ratio achieved on the basis of the previous studies made by EKONO Oy the total energy consumption has been allocated to different subprocesses. And in this way energy saving to be achieved has been calculated in proportion to the investment needed. The energy saving potential to be achieved by new automation systems at Finnish pulp and paper mills have thus been estimated at about FIM 150 million at the most, which is primarily directed to heat energy and to the use of cheaper fuel. The market prospects and the saving calculations show that at highly automated plants in Finland the main emphasis in the future will be on reporting, production control, and energy management systems covering the whole plant. Paying back the investment with energy saving is obvious only with the energy management system. Prospects of the measurement instruments and the development of the optimization of a unit process have not been evaluated. And the effect and prospects of the condition monitoring systems coming onto the market have not been evaluated.

11569 **(NP—7750594) Energy and chemical recovery by straw pulp manufacturing.** (Fredericia Cellulosefabrik A/S (Denmark)). Jun 1986. 24p. (In Danish). NTIS (US Sales Only), PC A02. File Number DE87750594.

The conclusion of previous experiments was that straw pulp can be produced by boiling using soda lye containing a catalyst and without sulphur. This boiling method makes it possible to carry out a combustion of black lye followed by chemical recovery after the DARS concept. The process consists of fluidized-bed combustion in which iron oxide is added to the black lye during the combustion. By leaching of the ashes with water soda lye with iron oxide as residue is produced directly. As no full scale plants using this concept exist it has been necessary to carry out combustion trials in pilot scale. The following trials have been performed: 1. Combustion of black lye in a fluid-bed furnace. 2. Evaporation of black lye in a pilot plant. 3. Removal of wax from the cellulose.

11570 **(NP—7750612) Economic competitive power of alternative energy systems for farmsteads.** Kryhlmand Iversen, K. (Statens Jordbrugsoekonomiske Inst., Valby (Denmark)). Dec 1985. 90p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750612.

The analysis includes these energy systems: 1) Oil burners; 2) Automated straw burners; 3) Pigsty heat pumps; 4) Windmills, power producing; 5) Biogas systems, heat producing; 6) Biogas systems, heat and power production; 7) Composting heat systems. In most circumstances oil burning is a medium competitive way of heat supply. If fiscal aspects are excluded from the cost calculations, oil burning generally turns out to be the most profitable energy source. With a thermal efficiency of 45% and a straw price of 0.25 DKr./kg straw burning accounts for the lowest or second lowest energy cost. At heat requirements above 20,000 liters a year the automized straw burner typically turns out to be the most economical energy source. With an energy factor of 3, not uncommon in practice, heat pumps with (or without) supplementary oil burning are more profitable than regular oil burning. In several cases heat pumps are even able to compete with straw burning. Windmills may turn out to be unrivalled by the other sources, if the local price of electricity is at least 0.40 DKr/kWh (excl. taxes) and the investor expects a working period of 18 years. However, windmills cannot compete in built-up areas, woodland and agricultural areas with many quicksets. Nor can they pay back investments within a working period of only 10 years. For biogas systems - power and heat producing the calculations indicate lower costs the larger the heat requirements. At the same time, heat requirements should be above the equivalent of 20,000 liters oil a year, the working period expected to at least 10-15 years and a local kWh-price of not less than 0.40 DKr. excl. taxes. Power and heat producing biogas systems can prove to be in a good competitive position. Biogas systems - heat producing - and composting heat systems can compete only in favourable circumstances and if annual heat requirements exceed 25,000 liters oil.

11571 **(OA-Trans—2767) Example of heat recovery from steam distillation.** Zilly, G. (Electricity Council, London (UK)). Dec 1985. 7p. Electricity Council, 30 Millbank, London SW1P 4RD.

Translated from VDI-Berichte (FRG), 1982, No. 442, p. 35-40.

A way of saving heat from an intermittently operating steam distillation plant is presented. The idea of recovering the energy in the water vapor led to a solution where the contaminated vapour condenses and is used to produce clean, low-pressure vapour. The ratio of energy contained in this vapour to the electrical energy needed for compression is almost constant. The complete heat recovery plant is fully automatic.

11572 **(VTT-TUTK—411) Energy economic control of electricity consumption. Large industry.** Keronen, J.; Kinnunen, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1986. 61p. (In Finnish). NTIS (US Sales Only), MF A01. File Number DE87750646.

The purpose of this research work was to investigate the load control potentials of the large-scale industry in Finland. The work was done by sending inquiries and by visiting the biggest factories. The result of the work is, that nowadays the direct load control capacity is 10 percent of the total load of an average winter day. The capacity is, however, mainly reserved for the loss-of-load control. When the prewarning time is increased over 2 hours, 3-10 percent more potential is obtained depending on the length of the prewarning time. The load control capacity includes mainly electrolysis processes, different kinds of mechanical processes as well as clinker and melting processes. Restrictions on the research kept the study processes and their process control methods. Further research is needed mainly in two areas, which have a great influence on the total amount of load control capacity: investigation of the potentials in "no-process-type"-industry, and investigation of the impacts of changes in processes and in process time schedules on the load control potential.

11573 **(BG-Trans—15025) Development of energy-saving combustion system: 9, Development of self-recuperative burner.** Tabata, A.; Hosoi, K.; Tanaka, H. (British Gas Corp., London; Tokyo Gas Research and Development Inst. (Japan)). 1986. Translated from 30th annual technical report of the Tokyo Gas Research and Development Institue, pp 71-79. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900426.

The self-recuperative burner has been developed within the framework of the development of an energy-saving combustion system. This burner contains a heat exchanger and is of compact construction. It is suitable for use in a broad range of high-temperature furnaces such as forging furnaces, metal smelters, reheating furnaces and the like. To date we have produced three types of

burners with capacities of 100,000, 300,000 and 800,00 kcal/h. These have been subjected to various performance tests to assess their combustion characteristics and efficiency as well as tests aimed at improving their durability. Work is underway aimed at adaptation of the self-recuperative burner to aluminium melting and holding furnaces (crucible furnace), carrying out development work on furnaces containing this energy-saving combustion system and we report here on progress made in this work.

11574 (BG-Trans—15030) Development of gas-fired small-scale small-scale glass melting furnace. Nakamachi, I.; Yasuzawa, K.; Nakamura, T. (British Gas Corp., London; Tokyo Gas Research and Development Inst. (Japan)). 1986. Translated from 30th annual report of Tokyo Gas R and D Institute, pp. 143-153. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900422.

There are about 70 small-scale glass melting furnaces, so-called multipot furnaces, within our operating area, with a potential demand of 3 x 10^6 m^3/year. Recently, in order to increase gas sales in this area, we have developed glass melting furnaces of a new, hitherto nonexistent type, with the aim of reducing environmental pollution, saving energy and rationalizing the manufacturing process. These are glass melting furnaces of two types, a circular-arc arranged pot furnace and a straight-line arranged pot furnace. In field tests, savings in energy of 45% have been recorded for the circular-arc arranged pot furnace, and large-scale improvements in operational efficiency were obtained in the case of the straight-line arranged pot furnace.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 10831, 11417, 11432, 11455

11575 (EPRI-EM—4923-CCM) COGEN3: Cogeneration analysis software Version 1.3: User's guide. Duff, M.C.; Price, W.G.; Davis, A.N.; Manuel, E.H. (Mathematica, Inc., Princeton, NJ (USA). Mathtech Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 215p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920171.

Designing the most economical cogeneration system for a specific facility involves selecting exactly the right combination of technology, operating schedule, and fuel from a large number of options. The COGEN3 code enables utilities to optimize all aspects of a cogeneration project from conceptual design to economic resources.

11576 (KTM/E-D—105) Market prospects of automation systems in energy production and distribution, preliminary study. Oehlandt, D.; Mikkanen, M.; Nieminen, P.; Saarnio, A. (Ministry of Trade and Industry, Helsinki (Finland). Energy Dept.). 1986. 27p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87750652.

Market prospects of automation systems in energy production and distribution are studied. The questionnaire study was supplemented by interviewing power suppliers and consumers and with the help of the existing statistics, sources and approximations. According to the study the greatest prospects are at small boiler plants whose automation level varies considerably. Energy savings through automation at these plants varies between 100-250 GWh, the monetary value of which is FIM 7.5-18.8 million. Small plants may often have poor basic automation or none at all. In addition to this the demand is limited to solving individual problems like improving measurement and control techniques. The problems in question concern, of course also larger plants where the basic automation level is generally good. The combined use of plants connected with each other through power or district heating networks includes considerable savings potential. The monetary value of the total energy savings achieved through automation varies between FIM 8.3-21.2 million according to the study.

3209 Education And Public Relations

11577 (ESC-WR—85-24) Energy conservation-information for the neighbourhood. Interim report 1: Social diagnosis. Midden, C.J.; Weenig, W.H.; Schmidt, T. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum; Rijksuniversiteit Leiden (Netherlands)). Sep 1985. 142p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The authors describe the problems with respect to energy conservation behavior of low income groups living in rented houses in neighbourhoods. Cohesion within such neighbourhoods can be considered as a resultant of two components: social solidarity and the extent of interaction combined with an inclination to ask for help. This leads to four ideal-types of people which looks like an improvement of the typology of Warren. 26 refs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

11578 (N—86-31647) Space station propulsion technology. Annual progress report, 24 May 1985-23 May 1986. Briley, G.L. (Rockwell International Corp., Canoga Park, CA (USA)). 1986. 92p. (NASA-CR—178897; NAS—1.26:178897; RI/RD—86-226; REPT—0737P-105; APR—1). NTIS, PC A05/MF A01.

The progress on the Space Station Propulsion Technology Program is described. The objectives are to provide a demonstration of hydrogen/oxygen propulsion technology readiness for the Initial Operating Capability (IOC) space station application, specifically gaseous hydrogen/oxygen and warm hydrogen thruster concepts, and to establish a means for evolving from the IOC space station propulsion to that required to support and interface with advanced station functions. The evaluation of concepts was completed. The accumulator module of the test bed was completed and, with the microprocessor controller, delivered to NASA-MSFC. An oxygen/hydrogen thruster was modified for use with the test bed and successfully tested at mixture ratios from 4:1 to 8:1.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 10796, 10815, 10816, 10817, 10819, 10820, 10861, 11588, 11588, 11908

11579 (AD-A—173358/3/XAB) Phenomenological study of the behavior of some silica formers in a high-velocity jet fuel burner. Technical memo. Cawley, J.D.; Handschuh, R.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1985. 26p. (NASA-E—2711). NTIS, PC A03/MF A01.

Silicon-based materials are under consideration of a number of applications in aircraft and automotive gas turbine engines. The majority of these are monolithic components that benefit from the excellent high-temperature strength of some of these materials, e.g. sintered alpha silicon carbide and reaction-bonded silicon nitride. Another possible application is employing these materials in turbine-tip gas-path seals. The structural requirement of this application is minimal, however dimensional stability is crucial. The silicon-based material are unstable in the presence of oxygen at the high temperatures experienced in the engine. Protection from gross reaction is afforded when an adherent film of SiO_2 forms on the surface during oxidation. This film serves as a barrier across which mass transport must occur for further oxidation, leading to parabolic scale-growth kinetics. The class of materials which displays this behavior is termed silica formers. Samplers of four silica formers: single crystal SiC, sintered alpha-SiC, reaction sintered Si_3N_4 and polycrystalline $MoSi_2$, were subjected to a Mach 1 jet fuel burner for 1 hr, at a sample temperature of 1375 C (2500 F). Two phenomena were identified that may be deleterious to a gas turbine application of these materials.

11580 (CONF-8510176—, pp 232-239) **Measurement of oil film thickness on piston lands.** Hoult, D.P.; Rifai, M.S. (Massachusetts Institute of Technology, Cambridge). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

A laser fluorescence technique has been used to obtain measurements of the liner film thicknesses in a single cylinder motored engine equipped with a transparent cylinder sleeve. This technique and its usefulness in determining film thicknesses and oil accumulation on the piston lands are described. Preliminary results show that the boundary conditions on the piston rings are contrary to what is assumed theoretically. Film thicknesses between the liner and individual rings were shown to agree with theory.

11581 **(DTH-LET-RE—86-7) Interaction of liquid and gaseous fuels in the dual fuel engine.** Nielsen, O.B. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). Feb 1986. 92p. Danmarks Tekniske Hoejskole, Laboratoriet for Energiteknik, Bygning 403, DK-2800 Lyngby, Denmark.

Based on models in the literature, for the ignition of hydrocarbons and hydrogen a mathematical model has been developed to simulate the chemical interaction of the fuels. The model has the capability to simulate enginelike variations of temperature, pressure, and volume in order to compute ignition delays of dual fuel engines. For experimental validation of the model, tests have been conducted on a special ignition research engine. In the first stage of the investigations the engine was run on diesel oil or cetane as pilot fuel, and hydrogen, carbon monoxide, or methane were induced in intake manifold. For direct comparison with computations, further tests were conducted with n-heptane as pilot fuel and with induction of hydrogen. In all cases, induction of nitrogen was used as a reference to eliminate the influence of changes in oxygen concentration and specific heats. From the results of a number of parameter variations, the cylinder charge temperature (determined by intake temperature and compression ratio), the pilot fuel amount, and the flow of combustible gas were found to have the most significant influence on the ignition delay. The model has shown the capability to simulate the influence of different compression ratios and the chemical effect of the induction of hydrogen and carbon monoxide on the ignition delay, thereby offering a chemical explanation for the observed increase of ignition delay with the addition of hydrogen and carbon monoxide.

11582 **(FRNC-TH—1933) Numerical tool for the correlative study of the combustion phase in subdivided chamber reciprocating engine.** Valdes, L.C. (Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France)). 1982. 142p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE87750981.

Development of a simulation program improved by writing the transfer equations differently from the way they are normally used and by an algorithm for solving the energy balance equations, leading to stability of the results of the computation. A computer treatment, combined with the methods of discretization by finite elements, enables simulation of the operating cycle of any type of engine by modifying only the program data. 11 refs.

11583 **(LA-UR—86-3572) Three dimensional numerical simulations of the UPS-292-SC engine.** O'Rourke, P.J.; Amsden, A.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 60p. (CONF-870204—1). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001968.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

We present and analyze three-dimensional calculations of the spray, mixing and combustion in the UPS-292 stratified charge engine for three different operating conditions, corresponding to overall air-fuel ratios between 22.4 and 61.0. The numerical calculations are performed with KIVA, a multidimensional arbitrary-mesh, finite-difference hydrodynamics program for internal combustion engine applications. The calculations use a mesh of 10,000 computational cells, which conform to the shape of the piston bowl and cylinder and move to follow piston motion. Each operating condition is calculated from intake valve closure at 118° BTDC to 90° ATDC and requires approximately three hours of CRAY-XMP computer time.

11584 **(PB—87-116265/XAB) Direct injection of high-pressure natural gas in reciprocating engines. Appendices. Final report, September 1984-January 1986.** Hoppie, L.O. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Aug 1986. 70p. NTIS, PC A04/MF A01.

Various conventional approaches to igniting directly injected natural gas, together with various ways of achieving hypergolic combustion were compared on the basis of their projected chances of leading to diesel-like combustion. The hypergolic combustion schemes ranked highest, and several were subsequently investigated on a theoretical and experimental basis. One of these schemes was based on electrical activation of the gas prior to injection and showed diesel-like performance in a direct-injected reciprocating engine. The second scheme is based on activation via partial catalytic combustion and is believed to be capable of comparable performance. Studies of the gas-pressurization system show that the total system efficiency will be highest if compression to the required injection pressure is carried out at constant temperature, but for the near term, a two- or three-stage intercooled system will probably be employed.

3302 External Combustion Engines

11585 **(EUR—9444) Study and construction of a sealed electric output 3 kW stirling engine breadboard model.** Dancette, M.; Wintrebert, G. (Commission of the European Communities, Luxembourg). 1984. 248p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

A 3 kW Stirling engine breadboard model has been designed, manufactured and tested by Bertin et Cie. The design is based on electric output from a sealed motor, two free power pistons and a displacer piston guided by dry-friction bearings, with no lubrication. Major applications of the Stirling contemplated by BERTIN are the following: - multi-fuel electric generator on remote sites for domestic uses, telecommunications, etc., - coal-fired, total energy, industrial electric generator, - three-temperature Stirling engine, with built-in refrigerating cycle and prime mover cycle, total energy operated, for heat pump, air conditioning or refrigerating applications.

3303 Electric-powered Systems

11586 **(LFE—85018) Test of Whisper electric car No. VE9aa 1032e 100 1003. Prepared for Whisper Electric Car A/S.** Nissen, O. (Laboratoriet for Energiforskning, Odense (Denmark)). Oct 1985. 59p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87750604.

The electric car's operational data as current, voltage, energy consumption, and speed are tested. Range and performance are: a) 105,9 km range at a constant speed V = 60 km/h; b) 48,7 km range at cyclus test SAE J 227aC (+ 10 km at constant speed of 40 km/h); c) acceleration 0 - 50 km/h 16 seconds. The current limit adjusting and thereby the starting current is comparatively high and a better driving economy may be obtained by reducing it. The charger has a good characteristic and treats the batteries smoothly, having at the same time sufficient capacity for quick charging with rather large effect.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 11580

3307 Emission Control

REFER ALSO TO CITATION(S) 11702

11587 **(ESC-WR—85-27) Consequences of environmental policy for private passenger transport.** Scheele, D. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Nov 1985. 18p. (In Dutch). Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The member states of the European Community have agreed to diminish the amount of noxious exhaust gasses of passenger cars drastically by the beginning of the 1990's. This paper reports on the consequences of agreed upon emissions and energy use in private passenger transportation up to the year 2000. Expected technological innovations in passenger car engines are taken into account and different levels of desired passenger car mobility are distinguished. Leading principle in the calculation is that car owners minimize costs when using existing cars or investing in new cars. 8 tabs.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 10796, 10815, 10816, 10817, 10819, 10820, 11581

11588 **(EUR—9714) Optimal adaptation of types of internal combustion engines with gas producers.** Callewaert, A.; Martin, J.; Wauters, P. (Commission of the European Communities, Luxembourg). 1985. 40p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

A detailed modelling of energy conversion from solid fuel into gaseous fuel has been developed on the basis of experiments with several types of gas producers. It has been shown that an air-steam process including heat recovery leads to the highest gasification efficiency and to the highest heating value of the gas. A thorough study of the burning properties of several types of producer gases on engines has shown that air-steam gas burned on the low compression ratio spark-ignited engine leads to the same engine efficiency as air gas burned on the high compression ratio engine. Furthermore, a higher power output is delivered by the air-steam gas engine. In the same way, diesel-gas engines are best fed at low compression ratio by an air-steam gas process to reach satisfying overall efficiencies.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

11589 **(AD-A—173162/9/XAB) Soviet noncompliance.** (Arms Control and Disarmament Agency, Washington, DC (USA)). 1 Feb 1986. 23p. NTIS, PC A02/MF A01.

Contents include: (1) ABM Treaty: Krasnoyarsk Radar, Mobility of ABM System Components, Concurrent Testing of ABM and Air Defense Components, ABM Capabilities of Modern SAM Systems, Rapid Reload of ABM Launchers, and ABM Territorial Defense, (2) SALT II Treaty: SS-25 ICBM, Strategic Nuclear Delivery Vehicle Limits, SS-16 ICBM Deployment, BACKFIRE Bomber Intercontinental Operating Capability, BACKFIRE Bomber Production Rate, Encryption of Ballistic Missile Telemetry, and Concealment of the Association Between an ICBM and Its Launcher, and (3) SALT I Interim Agreement: Use of Remaining Facilities at Former SS-7 Sites, Biological and Toxin Weapons Convention and 1925 Geneva Protocol, Chemical, Biological and Toxin Weapons, Limited test Ban Treaty, Underground Nuclear Test Venting, Threshold Test Ban Treaty, Nuclear Testing and the 150-Kiloton Limit, Helsinki Final Act, and Notification of Military Exercises.

3502 Proliferation

11590 **(AD-A—172835/1/XAB) Middle Eastern strategic deployment - oasis or mirage. Master's thesis, August 1985-June 1986.** Howard, S.B. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA)). 6 Jun 1986. 127p. NTIS, PC A07/MF A01.

This study assesses the feasibility of the United States deploying its planned military forces for the protection of its national interests in the Middle East, within time constraints previously established in our Southwest Asian contingency plans. The actual deployment feasibility was determined based upon comparisons of historical and current-day, transportation-related strategic military deployments. Past deployments by the United States to Europe in 1944 (Normandy Invasion), to Lebanon in 1958, to Grenada in 1983, and by the United Kingdom to the Falkland Islands in 1982, as well as recent Joint Readiness Exercises, were analyzed. Thus, common transportation-related problems served to identify the general causes for delays in the smooth movement of American military forces. This study identified three consistent causes of delays in strategic deployments; (1) Lack of adequate deployment training, (2) Inadequate coordination of operational requirements, and (3) Failure to execute specific details in pre-established contingency plans and procedures. The study concludes that the United States is not capable of successfully deploying its combat forces to the Middle East within the time schedules contained in our current contingency plans. This lack of force projection capability is attributed to delays that will be encountered because of unanticipated transportation-related problems. This study cites a weakness in the structure of Army and Joint Commands at Division level and above. The weakness, as identified, shows that the contingency planning function is separated from contingency execution/operations functions within these command structures.

11591 **(AD-A—173275/9/XAB) Combat casualities in a conventional and chemical warfare environmenmt.** McCaughey, B.G.; Garrick, J.; Kelley, J.B. (Naval Health Research Center, San Diego, CA (USA)). Feb 1986. 8p. (NAVHLTHRSCHC—86-9). NTIS, PC A02/MF A01.

Soldiers are faced with the possibility of fighting in an environment where chemical and conventional weapons are used at the same time. Conventional weapons could cause wounds that would render the use of the gas mask ineffective and thus subject the soldier to the deleterious effects of the chemical agent. It was predicted that 34% of the casualties requiring hospitalization would not be able to use the gas mask effectively due to wounds, and that this could result in death, additional incapacitation, or complications in treatment depending on the effect of the chemical agent. Strategies should be developed to deal with anticipated problems.

36 MATERIALS

REFER ALSO TO CITATION(S) 10694, 11748

11592 **(DOE/ER/45183—2) Materials research utilizing NSLS [National Synchrotron Light Source]: Progress report.** Liedl, G.L. (Purdue Univ., Lafayette, IN (USA)). Aug 1986. Contract FG02-85ER45183. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003982.

Research was conducted using NSLS synchrotron radiation on the following: decomposition kinetics of a supersaturated Ni-Si alloy, hexane monolayers on graphite, layering of $Fe(CO)_5$ on graphite, charge density waves, aging of Al-Li, superlattices in ternary MBE-grown semiconductor films, phase transformation in Cu-Be and Al-Zn, microstructural changes in complex alloys, diffuse x-ray scattering, ion conduction in Ag-Ge-Se glass, organic monolayers of the Langmuir Blodgett type, and residual stress in coating. (DLC)

11593 **(LBL—22057) μ SR: 86 report on the 4th International Conference at Uppsala.** Crowe, K.M. (California Univ., Berkeley (USA)). Aug 1986. Contract AS03-81ER40004;AC03-76SF00098. 20p. (CONF-8606134—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000077.

From 4. international conference on muon spin rotation, relaxation and resonance; Uppsala, Sweden (1 Jun 1986).

In this summary the author has chosen to examine a few central problems of the science of μSR, to let the readers outside the field catch a glimpse of the excitement of the subject, and to defer matters of science policy to others.

11594 **(MLM—3401) High strength glass-ceramic to metal seals.** Haws, L.D.; Kramer, D.P.; Moddeman, W.E.; Wooten, G.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1 Dec 1986. Contract AC04-76DP00053. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004040.

In many applications, ceramics are joined to other materials, especially metals. In such cases, interfacial strength is as important as the strength of each constituent material. Examples are presented for tailoring materials and processes to optimize the glass-ceramic-to-metal seal. Means for detecting defects, nondestructively, are also identified.

11595 **(MLM—3403) Chemistry of glass-ceramic to metal bonding for header applications: 2. Hydrogen bubble formation during glass-ceramic to metal sealing.** Craven, S.M.; Kramer, D.P.; Moddeman, W.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 3 Dec 1986. Contract AC04-76DP00053. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004041.

During the formation of a glass-ceramic to metal seal with nickel-based superalloy Inconel 718, hydrogen bubble formation was observed in the glass-ceramic. This bubble formation was caused by the reaction of dissolved metals with adsorbed water, all of which are in the glass-ceramic. The dissolved metals are present in the glass from dissociation of the Inconel 718, and the water is present in the glass prior to seal formation. To inhibit bubble formation, the glass-ceramic was spiked with 1 wt % CuO. This spiking allowed competing reactions to occur, thus causing the formation of copper and/or Cu_2O in the glass-to-metal interface and reducing bubble formation. Spiking with 1 wt % Cr_2O_3 also inhibited bubble formation. Thermodynamic data suggest that hydrogen formation is responsible for bubbles in a wide variety of seal systems, including glass-to-metal seals in which the metal is or contains iron, manganese, chromium, niobium, titanium, or aluminum.

11596 **Physics and chemistry of protective coatings.** Sproul, W.D.; Greene, J.E.; Thornton, J.A. (eds.). New York, NY; American Institute of Physics (1986). 179p. (CONF-8504259—). American Institute of Physics, 335 E. 45th St., New York, NY 10017 $48.00.

From Conference on physics and chemistry of protective coatings; Universal City, CA, USA (12 Apr 1985).

Ten papers are presented on mechanically hard, wear-resistant and corrosion-resistant coatings. One paper, sponsored by US DOE, is abstracted separately. (DLC)

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 10739, 10741, 11119, 11133, 11145, 11154, 11182, 11205, 11205, 11205, 11206, 11206, 11208, 11210, 11211, 11212, 11213, 11214, 11215, 11216, 11217, 11220, 11222, 11227, 11228, 11229, 11243, 11373, 11407, 11749, 11780, 11816, 11816, 11868, 11923, 12085, 12087, 12088, 12089, 12090, 12091, 12092, 12093, 12094, 12095, 12096, 12097, 12098, 12099, 12100, 12101, 12102, 12103, 12104, 12105, 12106, 12107, 12108, 12109, 12241, 12585, 12873, 12873, 12943

11597 **(AD-A—172313/9/XAB) Interdisciplinary approach to predictive modeling of structural adhesive bonding. Characterization of Ti-6Al-4V oxides and the adhesive/oxide interphase. Semi-annual report No. 88, September 1985-March 1986.** Filbey, J.A.; Wightman, J.P. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Center for Adhesion Science). Aug 1986. 36p. (CAS/CHEM—6-86). NTISMF A01.

Ti-6A1-4V, a high-strength, light-weight corrosion-resistant alloy, possesses many applications for structural adhesive bonding. This report covers the interaction of pretreated surfaces with heat, alkoxide primers, thin polymer films, structural epoxy, and hostile environments. The stability of the oxides at temperatures of 450 C is shown. Alkoxide primers enhance the durability of adhesively bonded aluminum. Characterization of alkoxide primers on Ti-6-4 has begun, as well as evaluation of these primers in the wedge test. Thin polymer films on polished titanium are studied by grazing-angle infrared spectroscopy. STEM, AES and XPS show the penetration of FM-300 into the porous oxide of CAA. Finally, the wedge test examines pretreatment stability in a variety of environments.

11598 **(AD-A—173217/1/XAB) Study of the enhanced thermionic emission of molybdenum, hafnium and zirconium due to dispenser-cathode exposure. Final report, September 1982-September 1985.** Hickey, J.B. (Utah Univ., Salt Lake City (USA). Dept. of Electrical Engineering). Sep 1986. 47p. NTIS, PC A03/MF A01.

Hafnium, zirconium, and molybdenum were studied in a tube environment to determine their levels of thermionic emission following exposure to a 4:1:1 dispenser cathode operated at a brightness temperature of 1050°. In order to obtain a curve of equilibrium emission density versus temperature, the temperature of the sample under study was varied above and below that of the source. Once equilibrium was reached at each temperature, the emission was recorded. Variations in surface temperature alter the Ba/BaO coverage, and hence the work function. The change in work function with coverage is much greater for low coverage and the measured emission therefore followed the typical S-shaped variation of metals placed in alkali and alkaline-earth vapor streams. From emission densities the effectiveness work functions of the surfaces studied were calculated. Before exposure to the source cathode, calculated effective work functions were in good agreement with published values. Thermal-emission densities of hafnium and zirconium, after equilibrium exposure at the same temperature as the source, were found to be on the order of only a few microamperes.

11599 **(AD-A—173245/2/XAB) Investigation of material problems for high-temperature, high-power space energy-conversion systems. Final report, 1 May 1983-30 May 1986.** Jacobson, D.L.; Morris, J.F.; Ramalingam; Snir; Bice. (Arizona State Univ., Tempe (USA). Coll. of Engineering). Jul 1986. 415p. NTIS, PC A18/MF A01.

This final report has been divided in six sections. The first one is an introduction. In the second section, the theory of dilute-solution ultralloys from tungsten sintering with special eutectic applications is presented, together with a comprehensive literature survey including 95 references. In the third one, the results for the work-function evaluation of tungsten-rhenium sintered alloys, obtained by using thermionic-emission microscopy, are presented. The influence of rhenium content in the range 3 to 30%, and temperature, between 1946 to 2339K in the work function are reported. The fourth section includes determination of the effective work function, normal spectral emissivity, recrystallization temperature and microhardness of tungsten-rhenium and tungsten-rhenium-thoriated alloys, in the temperature range between 1400 to 2500K. Section No. 5 summarizes the research on the influence of heating time, temperature, and alloying content of rhenium in the work function of tungsten alloys as determined in the vacuum-emission

vehicle. Finally, in the last section, the mechanical properties of tungsten-30% rhenium were investigated by using an Instron tensile testing equipment with a high-temperature, ultrahigh-vacuum system. The relationship between the normalized Young's modulus, ultimate tensile strength, yield strength, elongation, and test temperature was examined.

11600 **(AD-A—173515/8/XAB) Prompt charge collection in gallium arsenide diodes struck by energetic heavy ions. Final report, May 1983-December 1985.** Gilbert, R.M.; Ovrebo, G.K.; Schifano. (Harry Diamond Labs., Adelphi, MD (USA)). Sep 1986. 111p. (HDL-TR—2087). NTIS, PC A06/MF A01.

Charge collection was measured as a function of reverse-bias voltage on GaAs Schottky barrier diodes bombarded with heavy, energetic ions. Ion species included in the study were copper (57 MeV), chlorine (62 MeV), oxygen (18 MeV), and, to establish a baseline for comparisons, ^{241}Am decay alpha particles (5.4 MeV). Measurements of the drift component of collected charge are compared to funneling predictions based on the Hu and McLean Oldham models. Results show that significant funneling occurs in these gallium arsenide diodes, in reasonable agreement with predictions for the lighter ions, but to a lesser extent than predicted by both models for the heavier ions. Comparing these results with data on silicon diodes published in the literature shows that gallium arsenide is less responsive to heavy ion strikes than silicon. This enhances the value of the gallium arsenide technology for systems required to operate in environments containing high energy heavy ions, such as cosmic rays in the exoatmosphere.

11601 **(AD-A—955141/7/XAB) USAEC (US Atomic Energy Commission) coordinated program on irradiation effects on structural materials. Quarterly progress report No. 1, 1 May-31 July 1962.** Steele, L.E.; Hawthorne, J.R. (Naval Research Lab., Washington, DC (USA)). 31 Jul 1962. 16p. (NRL-MR—1351). NTIS, PC A02/MF A01.

The USNRL is one of nine laboratories participating in the USAEC Coordinated Program on Irradiation Effects on Structural Materials. Studies on the notch ductility of irradiated steels and on the effects of postirradiation heat treatment on notch ductility behavior are being conducted by the NRL Metallurgy Division as one part of this program.

11602 **(BNL—38686) Synchrotron radiation photoemission studies of CO chemisorption on Pt/Ta(110) and Ni/Ta(110).** Ruckman, M.W.; Pan, X.; Shek, M.L.; Strongin, M. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 19p. (CONF-861019—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003202.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

The effect of overlayer structure and electronic density near the Fermi level on CO chemisorption is studied for Pt/Ta(110) and Ni/Ta(110) by angle-resolved synchrotron radiation photoemission spectroscopy. Ni and Pt have distinctly different overlayer growth modes, but undergo similar modification of their valance band d-states when in contact with a Ta surface. Ni agglomerates on Ta(110), while Pt accumulates layer-by-layer. Exposure of an ultrathin ($0 < \theta < 2$ML) Ni/Ta(110) film to CO causes partial dissociation of the adsorbed CO leading to the coexistence of CO, C and O on the surface. Examination of the data suggests that the fractions of CO adsorbed and dissociated on the surface can be used to determine the amount of Ni clustering on the Ta(110) surface. When the surface is cooled to 80K only molecular CO adsorption is observed. Thick Ni films, also, adsorb molecular CO. Dissociative CO adsorption is observed for submonolayer films of Pt/Ta(110). At Pt coverages greater than a monolayer, molecular CO chemisorption is observed. No CO adsorption, either dissociative or molecular, is observed for monolayer coverages of Pt. Cooling a Pt/Ta(110) monolayer to 80K induces CO molecular adsorption.

11603 **(CONF-841203—11) Time and temperature-dependent processes affecting near threshold fatigue crack growth.** Gerberich, W.; Wright, A.; Lei, M.J. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science; Metallurgy Bureau, Louyang (China)). 1984. Contract AC02-79ER10433. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002225.

From 6. international conference on fracture; New Delhi, India (4 Dec 1984).

In a series of Fe-base alloys, the importance of low temperature on the effective driving force for fatigue crack growth is delineated. It is shown that both a crack-opening stress intensity factor and an effective stress intensity factor contribute to threshold. Both factors increase substantially as test temperature is reduced from 300 to 123°K.

11604 (CONF-8510176—, pp 146-154) **Limits of applicability of models predicting initiation of crack growth for surface cracks.** Reuter, W.G. (EG & G Idaho, Inc., Idaho Falls). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

In predicting the integrity of a structural component containing surface cracks, the general approach for plane strain, linear-elastic conditions is to use the plane strain fracture toughness and appropriate analytical solutions. The general adequacy of this approach has been verified although the accuracy has not been quantified for many conditions. For conditions of increased ductility (elastic-plastic, E/P, and plastic) it is possible to measure the J-integral associated with initiation of crack growth and the tearing modulus. There are no generally accepted analytical solutions for predicting the behavior of a generic surface crack. Results obtained by comparing predicted stresses with experimentally determined stresses for crack initiation and crack penetration of the wall thickness are summarized. Test data were generated for A710 and Ti-15-3 for elastic conditions and A710 for E/P and plastic conditions.

11605 (CONF-8510176—, pp 155-166) **Dynamic moire interferometry in mechanics research.** Epstein, J.S.; Deason, V.A.; Reuter, W.G. (EG & G Idaho, Inc., Idaho Falls). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

A brief review of moire interferometry is presented and some of the innovative concepts being pursued in dynamic moire interferometry are outlined. Two areas will be highlighted: the stress wave crack diffraction problem in steel, and the local effects of structural crack tip resonance in steel.

11606 (CONF-8510176—, pp 167-173) **Assessment of creep-fatigue crack growth behavior.** Jaske, C.E. (Battelle's Columbus Div., OH). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The application of inelastic fracture mechanics concepts to creep and creep-fatigue crack growth was evaluated. Experiments were performed on Type 316 stainless steel at 593 and 649 C. The C*-integral parameter was found to characterize creep-crack growth rate and the time-dependent portion of creep-fatigue crack growth rate. The J-integral parameter was found to characterize the cyclic portion of creep-fatigue crack growth rate. A crack-tip-zone interaction model was developed to account for creep-fatigue interaction effects during crack growth. The overall approach was applicable to short cracks (in the range of 0.05 to 1.5 mm) as well as to long cracks (in the range of 25 to 35 mm). Particularly relevant to engineering applications, crack-growth data have been developed for rates as low as 1e-11 m/sec (0.31(mm/year) under creep conditions and for rates as low as 2e-10 m/cycle under fatigue conditions. It was shown that inelastic fracture mechanics provides a useful engineering tool for assessing creep and creep-fatigue crack growth.

11607 (CONF-8510176—, pp 204-212) **Electrochemical wear of steel.** Beck, T.R.; Mabe, J.H. (Electrochemical Technology Corp., Seattle, WA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Studies have been made of wear of steel by a lubricated nylon polishing cloth without abrasives. Lubricants used were mineral oil, phosphate ester fluids and aqueous solutions, all filtered through 0.1 μ pore Nuclearpore polycarbonate filters. Effects of lubricant feed rate, peripheral velocity of cloth, and load were determined. The observed wear was clearly chemical or electrochemical in nature. Electrokinetic wall current were also measured using a single nylon filament on the shaft and a line electrode in a plane journal. The ac wall current pulses generated are apparently sufficient to account for the corrosive wear.

11608 (CONF-8609217—1) **Development of thin foils for use in generating neutral particle beams.** Aaron, W.S.; Zevenbergen, L.A.; Adair, H.L.; Culpepper, C.A.; McCulla, W.H.; Nolan, T.A.; Hughes, M.R. (Oak Ridge National Lab., TN (USA). Operations Div.; Los Alamos National Lab., NM (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1986. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000520.

From Neutral particle beam annual program review; Los Alamos, NM, USA (30 Sep 1986).

The Isotope Research Materials Laboratory (IRML) was requested to prepare large-area, ultrathin aluminum and carbon foils for use in beam neutralization experiments. There were two major parts to this request. The first was to immediately provide a number of 5-cm-dia foils 5 to 20 $\mu g/cm^2$ thick for use in experiments at the Fusion Materials Irradiation Test (FMIT) facility and at Argonne National Laboratory (ANL). The second, longer-term request was to develop methods to prepare 25-cm x 25-cm, 10-$\mu g/cm^2$ aluminum neutralizer foils. Both parts of the request have been successfully met.

11609 (DOE/ER/45025—14) **Artificially structured superconductors: Progress report.** Falco, C.M. (Arizona Univ., Tucson (USA)). 14 Oct 1986. Contract AC02-83ER45025. 24p. NTIS, PC A02; 3; GPO Dep. File Number DE87004007.

We have been conducting an experimental study of the preparation and structure of artificial metallic multilayers, as well as the superconducting properties of weak links in these materials. The major objective of this research is to produce materials with higher structural perfection than that achieved to date. A large portion of our efforts for the past three years was devoted to growth and sample characterization. A second objective has been to investigate the usefulness of these materials for superconducting weak links.

11610 (DOE/ER/45149—2) **The role of passive surface films on corrosion fatigue crack initiation: Technical progress report.** (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Metallurgical Engineering and Materials Science). 1987. Contract FG02-84ER45149. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003452.

This report describes research progress for the period up to February 28, 1987 of an ongoing grant to study, measure and model the roles of a passive surface layer and the underlying microstructure in controlling corrosion fatigue crack initiation and subsequent lifetimes. Recent work completed as part of this study has yielded a model which successfully predicts corrosion fatigue behavior of A-286 stainless steel. The model is based on a dissolution-repassivation mechanism and describes corrosion fatigue properties in terms of measurable or obtainable electrochemical and mechanical parameters. Work in progress will extend this study to another material and environment system in which key parameters can be better controlled and independently measured in order to advance both the model and the general understanding of corrosion fatigue initiation under passive conditions.

11611 (DOE/ER/45173—1-12/86) **Corrosion Research Center of the University of Minnesota: Progress report for the period January 1, 1986-December 31, 1986.** Oriani, R.A. (Minnesota Univ., Minneapolis (USA)). Dec 1986. Contract FG02-84ER45173. 240p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003776.

Research on aqueous corrosion and high-temperature corrosion is reported. (DLC)

11612 (DOE/ER/45179—T1) **Mechanisms of the oxidation of metals and alloys: Annual progress report for the period 1 July 1985 to 30 June 1986.** Yurek, G.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 27 Aug 1986. Contract FG02-85ER45179. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003389.

Areas of research conducted during this period were oxidation/sulfidation of pure chromium, Fe-25 wt % Cr, and Fe-25 wt % Cr-10 wt % Al alloys, segregation of sulfur to grain boundaries in oxide scales, oxidation of rapidly solidified (crystalline) Fe-Cr-Ni-Si alloys, and oxidation of Cr-Y and Co-Cr-Y alloys. Work carried out in this program has demonstrated the occurrence of grain boundary segregation of sulfur in chromia and alumina scales and of yttrium in chromia scales. It has also been demonstrated that the segregated species cause a change in the growth rates of the scales, and, in the case of yttrium segregation, a change in growth mechanism and an increase in scale adherence.

11613 (DOE/ER/45179—T2) **High spatial resolution AEM observations of yttrium segregation in chromia scales growth on Co-45%Cr.** Przybylski, K.; Garratt-Reed, A.J.; Yurek, G.J. (Massachusetts Inst. of Tech., Cambridge (USA). Corrosion Lab.). 1986. Contract FG02-85ER45179. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003770.

The addition of so-called "reactive" elements such as yttrium to alloys enhances the protective nature of Cr_2O_3 or Al_2O_3 scales. An A.E.M. study has been performed of scales grown at 1000°C for 25 h in pure O_2 on Co-45%Cr implanted at 70 keV with 2 x 10^{16} atoms/cm^2 of yttrium. In the unoxidized alloys it was calculated that the maximum concentration of Y was 13.9 wt % at a depth of about 17 nm. SIMS results showed that in the scale the yttrium remained near the outer surface. The grain size of the chromia scale was 200 to 300 nm. No yttrium was found inside featureless grains. Yttrium was found on all the grain boundaries and in some particles within the scale.

11614 (DOE/ER/45188—2) **[Fundamentals of hardening and decohesion behavior in time-dependent cycle deformation]: Progress report, January 1, 1986-December 31, 1986.** Laird, C.; Bassani, J.L. (Pennsylvania Univ., Philadelphia (USA)). Aug 1986. Contract FG02-85ER45188. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003995.

During the last year experimental and theoretical studies have been progressing in parallel. A preliminary project on the cyclic creep fracture of copper and Cu-O and Cu-Pb alloys has been completed by Supersam studies and experiments on acoustic emission to bring out the details of the fracture processes. New experiments using Cu-Pb alloys with lower solute content have been begun. Studies of monotonic latent hardening have also been completed and have been used to understand the monocrystalline hardening law. The following points are emphasized: (1) When deformation begins on any slip system, the hardening rate is initially high and then decreases into easy glide; (2) In Stage I, the latent hardening on the secondary systems is lower than the self-hardening on the primary; (3) slip interactions from different systems produce stronger hardening than slip on a single system; (4) If primary slip already exists, the activation of the secondary system causes the self hardening rates of both systems to increase suddenly, but more so on the secondary system; (5) After the sudden increase, the self hardening rate decreases again but in a slower manner than in Stage I deformation. Single crystal plastic constitutive equations have been developed that are consistent with these observations.

11615 (DOE/NASA/16310—1) The effect of electron beam welding on the creep rupture properties of a Nb-Zr-C alloy. Moore, T.J.; Titran, R.H.; Grobstein, T.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. Contract AI03-86SF16310. 13p. (NASA-TM—88892; CONF-861076—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003578.

From Fall meeting of the Metallurgical Society of AIME; Orlando, FL, USA (5 Oct 1986).

Creep rupture tests of electron beam welded PWC-11 sheet were conducted at 1350°K. Full penetration, single pass welds were oriented transverse to the testing direction in 1 mm thick sheet. With this orientation, stress was imposed equally on the base metal, weld metal, and heat-affected zone. Tests were conducted in both the post-weld annealed and aged conditions. Unwelded specimens with similar heat treatments were tested for comparative purposes. It was found that the weld region is stronger than the base metal for both the annealed and aged conditions and that the PWC-11 material is stronger in the annealed condition than in the aged condition.

11616 (EPRI-EL—4909) Explosive fabrication of multilayer damper shield: Final report. Lalwaney, N.S. (Battelle Columbus Labs., OH (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 156p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920164.

Explosive bonding, a solid state bonding process capable of directly bonding dissimilar metals, was selected to fabricate a three layer nominally 36-inch-diameter and 13-foot-long outer damper shield for a 300 MVA superconducting generator. The material performance criteria required that the outside, fully aged Inconel 706 or 718 layers be metallurgically bonded to the copper-zirconium alloy core without affecting the metallurgical properties of the respective metals. It is demonstrated that 18-inch-diameter and 72-inch-long multilayer cylinders can be welded without affecting their metallurgical properties. Though due to the changed EPRI priorities, the project was terminated before the damper shield could be fabricated, results clearly indicate that 12 feet or longer multilayer composite cylinders can be explosively welded without the use of heavily machined external dies or internal mandrels.

11617 (EPRI-NP—4978-Vol.1) Evaluation of intergranular attack on Alloy 600: Volume 1, Evaluation of causes: Final report. Hermer, R.E.; Wolfe, C.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Steam Generator Technology Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1986. 197p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920184.

The objectives of this report are to assess the effects of alkaline species on IGA of Alloy 600 tubes in tubesheet and tube support plate crevices, and to select a reference environment for the evaluation of remedial measures.

11618 (ETN—6-97377) Magnetic properties in the paramagnetic area of two ferromagnetic superconductors. Ph.D. Thesis. Pruijmboom, A. (Technische Hogeschool Twente, Enschede (Netherlands)). May 1984. 77p. (In Dutch). NTIS, PC A05/MF A01.

Susceptibility measurements in the temperature range 1.5 to 4.2 K were carried out on an Ho/sub 1,2/Mo_6S_8 preparation and ErRh/sub 1,1/Sn/sub 3,6/ monocrystals using a SQUID and a 10T (i.e., a 0 to 10 Telsa magnetic field variability) susceptometer. A reliable value for the Curie-constant was found while calibrating the 10T disposition. Measurements at H=0 field strength yield an effective ground state moment of 10.16 muB/atom and a 0.11 K paramagnetic Weiss temperature dependance of the Curie-constant which corresponds to the existence of a still lower situated doublet with smaller effective moment is found. A model for the exchange of energy between the spin system, and the conduction electron system and the grid system (in which the conduction electrons exchange energy with the liquid He via the grid) was developed to explain the behavior of the relaxation time above lambda temperature.

11619 (ETN—6-97380) Investigation of three ferromagnetic superconductors in the milli-Kelvin area. Ph.D. Thesis. Gerritsen, E. (Technische Hogeschool Twente, Enschede (Netherlands)). May 1984. 98p. (In Dutch). NTIS, PC A05/MF A01.

The ternary bonds $Ho_{12}Mo_6S_8$ (1), $ErRh_4Sn$/sub 3,6/ (2), and $ErRh_4B_4$ (3), were prepared and investigated, using a ^3He-^4He mix-cooling machine to create a 100 mK temperature area in which superconductivity and ferromagnetic order can coexist. Direct current magnetization (DCMM's) and resistance measurements (RM's) were carried out using a SQUID. Crystals of (2) were prepared from Er:Rh melt ratios of 1:1 (a), and 1:2 (b). The DCMM's show ferromagnetic order at temperatures Tc2 of 0,75 K, and 0.52 K. The RM's show superconductivity for only a small part of the (a)-crystals at a temperature Tc1=0.5 K, but a complete superconductivity for the (b)-crystals at Tc1=1.07 K. Temperatures for which the crystals become normal again are 0.66 K (a), and 0.38 K (RM) and 0.52 K (DCMM) for (b). A method to reduce magnetization changes to absolute values for susceptibility was determined. For preparation (3) a Tc1=8.7 K is found.

11620 (FEI—1640) Application of variation method to multicomponent thermal diffusion in solid phase. Grigor'ev, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700416.

Further development of the variational method applicable to investigation into interaction of multicomponent diffusion with heterogeneous temperature gradient is given. Some equations of thermal diffusion derived by the principle of Lagrangian function extremity and use of notions of direct and indirect processes of diffusion mass transfer are obtained. A variant for plotting fundamental solution of certain differential Eiler-Lagrange equations for thermal diffusion is presented. A numerical example of effect of temperature gradient on carbon diffusion for the 1Kh15N16M3B steel is considered. 6 refs.; 2 figs.

11621 (IAE—4134/4) Determining equations of anisotropic plasticity of irradiated materials. Tutnov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700419.

Mathematical models of plastic deformation of irradiated materials are analyzed. Equations for isotropic and anisotropic materials with isotropic and isotroporelaying hardening are considered. Algorithms for obtaining material anisotropy coefficients both for massive billets and for thin-walled tubes are given. 3 refs.; 2 figs.

11622 (INIS-BR—546) Mechanical properties of laminated composites of Al 1100/Al 2024 in three aging states. Pessoa, C.S. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1984. 122p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700417.

Laminated composites consisting of alternating layers of Al 2024 were produced by hot rolling, with a volume fraction of 49% of Al 2024. These composites used in nuclear reactor tecnology, were given under-aging, aging and over-aging heat treatments at 448k for 1h, 4h and 96h, respectively. Tests of microhardness, tension and fatigue in the divider orientation were performed.

11623 (INIS-SU—352, pp 381-383) Ion-stimulated gas desorption from stainless steel and copper surfaces under high vacuum. Kalinin, Yu.Zh.; Rogozinskij, V.G.; Ushkov, V.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The results of the experimental investigation of ion stimulated desorption of CO_2, Ar, N_2+CO and H_2 gases under 10^{-9}-10^{-7} mm Hg pressure performed using the model of vacuum chamber of the IHEP accelerating and storagefacility (ASF) are presented.

Inside the model of 12Kh18N10Tstainless steel of 3.8 m length and diameter - 70mm a cylindrical ion collector manufactured of the same steel which isa bombarded surface is placed. The collector diameter is 60 mm, length - 600 mm. Along the collector axisthe axial positive electrode of 4 mm diameter is located to which 3-7 kV voltage is supplied. In the cell formed by the axial electrode and ion collector inmagnetic and electric crossedfields the inverse magnetotron type discharge is ignited. It is shown that the values of total and partial coefficients of ion stimulated desorption for stainless steel and copper are independent of pressure and energy of bombarding ions. The conclusion is drawn on correctness ofdata on ion stimulated desorption taken for the IHEP ASF design.

11624 (IWGFPT—24, pp 127-133) **Effect of hydrogenation on corrosion behavior of austenitic stainless steels.** Kropachev, V.S.; Bogoyavlensky, V.L.; Korobov, N.I.; Kuchin, O.P. (All-Union Scientific and Research Institute of Inorganic Materials, Moscow, USSR). Feb 1986. NTIS (US Sales Only), PC A07/MF A01. File Number DE86901669. (CONF-8510310—).

From Technical committee meeting on external cladding in water power reactors; Cadarache, France (14 Oct 1985).

The influence was studied of electrolytic hydrogenation on the austenitic stainless steels (X18H10 and X17H15M3) potentiodynamic behavior, structure, surface condition, tensile properties and resistance to intergranular corrosion and corrosion assisted cracking. The paper discusses the mechanism of the effect of penetrated hydrogen on the behavior of the steels.

11625 (K/TS—11801) **Evaluation of commercially available coating techniques for application of thermographic phosphor to nickel-based alloys.** Beshears, D.L.; Bridges, M.J.; Harris, L.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1986. Contract AC05-84OT21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003556.

Remote temperature measurements using laser-induced fluorescence of phosphors has been established for temperatures ranging from room temperature to 1200°C. This remote surface thermometry requires that the phosphors be firmly bonded to the surface of interest. The intent of this paper is to take a quick look at several bonding techniques used to bond the thermographic phosphor yttrium oxide doped with europium (Y_2O_3:Eu) to nickel-based alloy. The evaluation of the samples were performed after the samples had been subjected to extreme heat and, in some cases, mechanically deformed.

11626 (KFKI—1986-77/E) **Influence of magnetic annealing on shear modulus and internal friction of $Fe_{78}Si_{10}B_{12}$ metallic glass.** Malkinski, L.; Kiss, S.; Kiss, L.F.; Vertesy, Z. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Polska Akademia Nauk, Warsaw. Inst. Fizyki; Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Alkalmazott Fizikai Intezet). 1986. 14p. (CONF-8609212—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900268.

From 3. international conference on physics of magnetic materials; Szczyrk-Bita, Poland (9 Sep 1986).

Shear modulus and internal friction dependences on magnetic bias field were investigated. Considerable improvement of the piezomagnetic properties of $Fe_{78}Si_{10}B_{12}$ metallic glass was achieved by low-temperature (260°C) heat treatment in perpendicular magnetic field (12 kA/m). However, various samples from the same amorphous ribbon show largely different behavior versus magnetic field. The problem is discussed in the paper.

11627 (KFKI—1986-78/E) **Density of Fe-Si-B metallic glasses.** Malkinski, L.; Konczos, G. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics; Polska Akademia Nauk, Warsaw. Inst. Fizyki). 1986. 14p. (CONF-8609212—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900269.

From 3. international conference on physics of magnetic materials; Szczyrk-Bita, Poland (9 Sep 1986).

Densities of selected Fe-Si-B metallic glasses were measured with accuracy of about 0.05% using Archimedean method. Also the influence of heat treatment on density was studied. The results of the measurements and a short discussion of the measuring errors are presented.

11628 (KFTI—84-13) **On a vacancy mechanism of oxidation reaction.** Tanatarov, L.V.; Savchenko, B.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1984. 49p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700420.

Kinetics of oxide layer growth on a metal surface is theoretically investigated. Diffusion equations for point defects, performing mass transfer taking into account sources and discharges, that are voids and dislocation loops in a non-oxidized metal, are written and solved. Oxidation reactions on the boundary of an oxide with gaseous oxygen are sources of Schottky vacancies. Cascades of collisions or single acts of the Frenkel pair production are sources in the presence of penetrating radiation. Time dependences of oxide layer thickness are obtained. Influence of electrical fields inside the oxide, as well as radiation action are taken into account. A total system of mass transfer equations under the oxidation conditions and penetrating oxidation action is formulated. If vacancy discharges are macrodefects in a non-oxidized metal, then the oxide thickness grows by the parabolic law. If defects grow in the oxide layer under penetrating radiation, then the law of oxide layer growth is linear. 6 refs.

11629 (KFTI—85-8) **Diffusion interation between voids at arbitrary distances.** Dubinko, V.I.; Tur, A.V.; Turkin, A.A.; Janovskij, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700421.

The problem on diffusion interaction between voids, placed at arbitrary distances from each other, is exactly solved in the paper. In different limiting cases simple analytical expressions for their growth and motion rates are obtained. Vacancy transfer from a less void to a larger one is shown to occur at short distances. The instability criterion for dimensions of two closely placed similar voids is found. Void evolution in a semiinfinite crystal is considered. The results obtained are applicable for description of diffusion interaction between gas-filled voids and precipitations. 7 refs.; 5 figs.

11630 (LA-UR—86-3978) **Contamination layers on EUV [extreme ultraviolet] reflectors.** Scott, M.L.; Arendt, P.N.; Cameron, B.J.; Newnam, B. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 8p. (CONF-861242—1). NTIS, PC A02. File Number DE87002900.

From International conference on soft X-ray optics and technology; West Berlin, F.R. Germany (8 Dec 1986).

We have utilized a visible in situ ellipsometer to investigate the growth of oxide surface layers on aluminum and silicon films deposited in an ultra high vacuum (UHV) system. A single molecular layer of oxide forms on the aluminum film surface in 1 hour when exposed to a partial pressure of 2×10^{-8} Torr of either oxygen or water vapor. The single molecular oxide layer that forms in 4 hours on silicon when exposed to 2.5×10^{-8} Torr of oxygen is SiO_2 if the vacuum ion gauges are operating, but it appears to be SiO if these gauges are turned off during the layer formation. The time of formation of these layers is inversely proportional to pressure. The growth rate of the oxide surface layer drops dramatically after formation of this first monolayer on both aluminum and silicon. Other gases, such as methane and carbon monoxide, were found to be essentially unreactive with the aluminum film.

11631 (LAFI—077) **Neutron topography study of large single crystals by the local rocking curves method.** Kuvaldin, B.V.; Zolotoyabko, E.V.; Iolin, E.M.; Raitman, E.A. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700344.

The degree of perfection of large single crystals of copper and silicon have been studied by the diffraction technique of local rocking curves (LRC). In the copper crystal the bending of atomic planes has been observed revealed as the monotonous variation on the sample thickness of the angular positions of LRC maxima. The theoretical basis of the method is given. The representation devel-

oped is used to explain anomalous dependence of LRC parameters in the perfect crystal. 9 refs.; 6 figs.

11632 (LBL—22026) Bonding and reactivity of unsaturated hydrocarbons on transition metal surfaces: Spectroscopic and kinetic studies of platinum and rhodium single crystal surfaces. Bent, B.E. (California Univ., Berkeley (USA)). Nov 1986. Contract AC03-76SF00098. 353p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87003533.

The surface chemistry of small, unsaturated hydrocarbons on platinum and rhodium single crystal surfaces has been investigated. Using a high pressure/low pressure apparatus capable of catalysis at atmospheric pressures and surface analysis in ultra-high vacuum, adsorbed hydrocarbon species have been identified by high-resolution electron energy loss spectroscopy (HREELS), low-energy electron diffraction (LEED) and thermal desorption spectroscopy (TDS). Catalytic hydrogenation of ethylene on Pt and Rh was also studied.

11633 (N—86-31648) Slip casting and extruding shapes of rhenium with metal oxide additives. 1: feasibility demonstration. Barr, F.A.; Page, R.J. (Page (R.J.) Co., Santa Ana, CA (USA)). Apr 1986. 17p. (NASA-CR—174970; NAS—1.26:174970). NTIS, PC A02/MF A01.

The feasibility of fabricating small rhenium parts with metal oxide additives by means of slip casting and extrusion techniques is described. The metal oxides, ZrO_2 and HfO_2 were stabilized into the cubic phase with Y_2O_3. Additions of metal oxide to the rhenium of up to 15 weight percent were used. Tubes of 17 mm diameter with 0.5 mm walls were slip cast by adapting current ceramic oxide techniques. A complete cast double conical nozzle demonstrated the ability to meet shapes and tolerances. Extrusion of meter long tubing lengths of 3.9 mm o.d. x 2.3 mm i.d. final dimension is documented. Sintering schedules are presented to produce better than 95% of theoretical density parts. Finished machining was found possible were requried by electric discharge machining and diamond grinding.

11634 (NIIAR—18(664)) Determination of elastic constants in matals by ultrasonic resonance method. Stupin, V.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700418.

Considered are the theoretical principles of the ultrasonic method for measurement of the elastic constants of the disk-shape samples. Described is the measuring device which makes possible the mechanical vibrations of the disks of about 30 mm in diameter to be excited and monitored. By using the samples of the structural steel 45 and tantalum the effect of the conditions of their fastening between the ultrasonic waveguides on the resonance spectrum of their own vibrations has been defined and the values for the Poisson factor, Young's and shear moduli, the bulk modulus and sound velocity estimated. The estimates obtained are in a good agreement with the available data. 8 refs.; 5 figs.; 6 tabs.

11635 (NUREG/CR—4573) Elastic-plastic finite element analysis of crack growth in large compact tension and circumferentially through-wall-cracked pipe specimen: Results of the first Battelle/NRC analysis round robin. Ahmad, J.; Nakagaki, M.; Papaspyropoulos, V.; Wilkowski, G. (Battelle Columbus Labs., OH (USA)). Oct 1986. 208p. (BMI—2135). NTIS, PC A10/MF A01 - GPO. File Number TI87900350.

As part of the Degraded Piping Program - Phase II, Battelle organized an international round robin involving elastic-plastic fracture mechanics analyses by the finite element method. Two crack-growth analysis problems were addressed: a large planform compact (tension) specimen of Type 304 stainless steel at 550°F (288°C), and a circumferentially through-wall-cracked pipe of Type 304 stainless steel, subjected to four-point bending at room temperature. The experimental data necessary for the analyses of both problems were supplied by Battelle. Participation in the round robin was sought from organizations in the US and abroad. For each of the two problems, five organizations (including Battelle) provided solutions. The results were first presented at the 1985 ASME Pressure Vessel and Piping Conference held in New Orleans in June 1985. Subsequently, the round-robin participants provided Battelle with written contributions describing the specific numerical modeling techniques used and the results. This report contains the compilation of these contributions and a comparison of the round-robin results.

11636 (NUREG/CR—4782) Development of an analytic key curve approach to drop tower J-R curve measurement. Joyce, J.A.; Hackett, E.M. (Naval Academy, Annapolis, MD; David W. Taylor Naval Ship Research and Development Center, Annapolis, MD (USA)). Dec 1986. 28p. NTIS, PC A03/MF A01 - GPO. File Number TI87900405.

The report describes the development of a dramatically improved method for evaluating J-R curves from 3 point bend specimens tested in a drop tower at loading rates of 2.5 m/second. Aluminum absorbers are used to eliminate the initial transient shock and produce data records smooth enough for direct application of key curve methods. An analytic key curve method is used which eliminates the need for tests on blunt notched or subsize specimens allowing development of a J-R curve for each specimen tested. Results are presented on an A533B steel showing the resulting J-R curve elevation as a function of test rate in comparison with standard static tests.

11637 (ORNL/Sub—85-22006/1) Investigation of correlation of carbide size and percentage with mechanical properties of high strength low alloy steels. Shaw, B.J. (Oak Ridge National Lab., TN (USA); Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jul 1986. Contract AC05-84OR21400. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87004000.

The final report on the DOE Contract 86X-22006C gives the results of statistical analyses and research conducted in the period March 1, 1985 to July 31, 1986. Data generated in the previous DOE Contract (DE-AC05-78ET13513) was combined with carbide analyses performed in this contract. The project was designed to establish the role of composition (Mo,Cr,Mn,Si,C,P) and tempering parameter ona range of steel properties using a statistical design with 32 samples. Models representing the carbides formed as a function of these variables led to constitution diagram for Cr-Mo steels. Further analyses included the role of composition, carbides and the tempering parameter on the yield and ultimate tensile strength, the ductile-brittle transition temperature, the room temperature Charpy impact energy and the threshold stress intensity in a moist H_2S environment. 28 refs., 24 figs., 25 tabs.

11638 (ORNL/TM—10126) Mechanical property measurements on ion-irradiated metals. Zinkle, S.J.; Oliver, W.C. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). Aug 1986. Contract AC05-84OR21400. 21p. (CONF-860421—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE86015969.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

A recently developed mechanical properties microprobe (MPM) has been used to investigate strength and elastic modulus changes in ion-irradiated metals. The indenter load and its displacement are simultaneously monitored while the indentation is being made and also during unloading. Microindentation hardness measurements have been performed on ion-irradiated copper and Cu-0.15% Zr (AMZIRC). The depth dependence of the ion damage has been investigated in selected specimens which were prepared using a cross-section technique. This procedure allows a direct comparison to be made of hardness data from different irradiation depths while the indent size is held constant. The displacement damage associated with ion irradiation caused either hardening or softening, depending on the irradiation conditions and the material.

11639 (PNL—6096) Assessment of the feasibility of developing a Hanford Site weld modeling program. Atteridge, D.G.; Anderson, W.E.; Klein, R.F. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003971.

Welding on the Hanford Site is an everyday occurrence, and most of the weldments made on site are relatively straightforward. Groove geometries, fillers, and wleding techniques and parameters are normally decided by experience or handbook advice. However, there are other weldments that might employ new materials, as well as one-of-a-kind welding situations. Implementation of a verified analytical weld assessment method would allow optimization of weld metal and heat-affected zone microstructure, and of variables that affect structural deformation and residual stresses. Realistic prediction of weldment thermal and strain history will require the use of a finite element model. Microstructure and resultant properties can be predicted using complex computer-based microstructure evolution models, literature-based empirical equations, or experimentally established behaviors. This report examines the feasibility of developing analytical methods for establishing weld parameter envelopes in new, complex welded configurations.

11640 **(PUC-TN—34/84) Criticality of the anisotropic quantum Heisenberg model on a simple cubic lattice.** Mariz, A.M.; Tsallis, C.; Santos, R.M.Z. dos; Santos, R.R. dos. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nov 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700347.

Within a Real Space Renormalization Group Framework, the criticality (phase diagram, and critical thermal and crossover exponents) of the spin 1/2 - anisotropic quantum Heisenberg ferromagnet on a simple cubic lattice is studied. The results obtained are in antisfactory agreement with known results whenever available.

11641 **Plasma deposition of amorphous metal alloys.** Hays, A.K. (to Dept. of Energy, Washington, DC). US Patent 4,626,448. 2 Dec 1986. Filed date 18 Jul 1985. v.p.

This patent describes a method of plasma-depositing amorphous metal alloy coatings on a substrate, consisting of dissociating vapors of organometallic compounds and metalloid hydrides in a reducing gas in a glow discharge environment. The ratio of the partial pressures of the organometallic and the hydride vapors is maintained at a level such that the metalloid content of the resulting coating is within the range of about 20 to 40 atomic percent. The plasma in the flow discharge is characterized by an average electron energy of 1 to 10 eV and electron densities of about 10/sup 9/ to 10/sup 12/cm/sup -3/, the energy being supplied at frequencies within the range of about 0 to 10/sup 10/ Hz.

11642 **Synthesis of new amorphous metallic spin glasses.** Haushalter, R.C. (to Dept. of Energy, Washington, DC). US Patent 4,626,296. 2 Dec 1986. Filed date 11 Feb 1985. v.p.

This patent describes an amorphous metallic precipitate consisting essentially of the formula (M/sub 1/)/sub a/(M/sub 2/)/sub b/ wherein M/sub 1/ is Fe and M/sub 2/ is SnTe/sub 4/ and the integers a and b which provide stoichiometric balance are respectively 2 and 1. The precipitate has been formed from a solution of chemical compound M/sub 1/X and YM/sub 2/ in a chemical solvent wherein YX are soluble in the solvent.

11643 **Hard metal composition.** Sheinberg, H. (to Dept. of Energy, Washington, DC). US Patent 4,626,281. 2 Dec 1986. Filed date 7 May 1985. v.p.

This patent describes a hard composition of matter having a Rockwell A hardness value of at least approximately 85, comprising the compressed and densified reaction product of: a minor amount of a boron carbide component selected from the group consisting of (a) boron carbide and (b) boron and carbon, the boron and carbon being present in amounts sufficient to form boron carbide in situ, wherein the boron carbide component consists essentially of B/sub 4/C; a major amount of a metal mixture consisting essentially of: (a) a first metal component selected from the group consisting of tungsten and molybdenum and mixtures thereof, and (b) a second metal component selected from the group consisting of nickel and iron and mixtures thereof; wherein the minor amount of the boron carbide component is between 3% and 6% by weight of the composition of matter when the first metal component is tungsten. The minor amount of the boron carbide component is between 6% and 10% by weight of the composition when the first metal component is molybdenum. The boron carbide component is between 3% and 10% when the first metal component is a mixture of tungsten and molybdenum, with the remainder of the composition being formed of the metal mixture, and wherein the first metal component is from 70% to less than about 90% by weight of the metal mixture when the first metal component is tungsten, and wherein the first metal component is from 72% to less than about 90% by weight of the metal mixture when the first metal component is molybdenum.

11644 **Magnetic structure of erbium.** Gibbs, D.; Bohr, J.; Axe, J.D.; Moncton, D.E.; D'Amico, K.L. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 8182-8185(1 Dec 1986).

We present a synchrotron x-ray scattering study of the magnetic phases of erbium. In addition to the magnetic scattering located at the fundamental wave vector tau/sub m/ we also observe scattering from magnetoelastically induced charge modulations at the fundamental wave vector, at twice the fundamental, and at positions split symmetrically about the fundamental. As the temperature is lowered below 52 K the charge and magnetic scattering display a sequence of lock-in transitions to rational wave vectors. A spin-slip description of the magnetic structure is presented which explains the wave vectors of the additional charge scattering.

11645 **Effect of strain on the elastic properties of superlattices.** Schuller, I.K.; Grimsditch, M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **4**: No. 6, 1444-1446(Nov 1986). Contract W-31-109-ENG-38.

The elastic properties of superlattices are strongly affected by strains in these materials. Elastic anomalies have been found in Nb/Cu, Mo/Ni, V/Ni, and Au/Cr superlattices. The strains measured with x rays explain quantitatively the elastic softening in Mo/Ni. An extension of these arguments explains not only the softening of Nb/Cu but the hardening and softening observed in Au/Cr. The origin of the strains is not known at the present time.

11646 **Appearance of correlation effects in U intermetallics.** Sarma, D.D.; Hillebrecht, F.U.; Speier, W.; Mrtensson, N.; Koelling, D.D. (Institut fuer Festkoerper-forschung, Kernforschungsanlage, D-5170 Juelich, Federal Republic of Germany). *Physical Review Letters;* **57**: No. 17, 2215-2218(27 Oct 1986).

Experimental densities of states of USi_3 and UIr_3 obtained by x-ray photoelectron spectroscopy and bremsstrahlung isochromat spectroscopy (BIS) are compared to fully relativistic self-consistent band-structure calculations. Very good agreement is found for USi_3, whereas the unoccupied states of UIr_3 exhibit a satellite which cannot be explained by the one-particle calculation. The satellite in BIS of UIr_3 is attributed to a quasiparticle bound state, and is qualitatively reproduced by a Hubbard model including Coulomb correlation within the narrow 5f band. The importance of our findings with reference to the magnetic properties of U intermetallics as well as pure U metal is discussed.

11647 **Evidence of FCC titanium hydride formation in β titanium alloy: An X-ray diffraction study.** Shih, D.S.; Birnbaum, H.K. (Dept. of Materials Science and Materials Research Lab., Univ. of Illinois at Urbana-Champaign, 1304 W. Green Street, Urbana, IL 61801). *Scripta Metallurgica;* **20**: No. 9, 1261-1264(Sep 1986). Contract AC02-76ER01198.

Three types of titanium hydrides have been reported: δ, ϵ and γ hydrides. The δ hydride forms in the composition range from TiH/sub 1.5/ to TiH/sub 1.99/ and has a CaF/sub 2/ structure with metal atoms on an fcc lattice and hydrogen atoms randomly occupying tetrahedral interstitial sites. At higher hydrogen concentrations, TiH/sub 2/, the fct ($c/a < 1$) ϵ hydride phase is formed below 310 K. The c/a ratio decreases with a decreasing temperature and it reaches and maintains a minimum value of 0.943 below 80 K. The fcc to tetragonal, $\delta \rightarrow \epsilon$ transformation is apparently diffusionless, similar to that operating in the cubic/tetragonal transformation in zirconium hydride. The metastable fct γ hydride having a

c/a value of 1.09 or 1.12 forms from solid solutions of hydrogen in the hcp α matrix. While the titanium hydride precipitation in α-Ti and its alloys has attracted extensive investigation, hydride formation in bcc β-Ti alloys has rarely been studied because they have not been thought to be liable to hydride formation. This paper shows conclusive evidence for the fcc δ hydride phase formation in the β phase Ti-30 wt% Mo by x-ray diffraction study.

11648 A percolation model for passivation in stainless steels. Sieradzki, K.; Newman, R.C. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY 11973). *Journal of the Electrochemical Society;* 133: No. 9, 1979-1980(Sep 1986). Contract AC02-76CH00016.

It is well-known that Fe-Cr, Ni-Cr, and Fe-ni-cr alloys require about 12 at.% chromium to become "stainless." The transition around 12% Cr is quite abrupt, especially when expressed as the change in passivation potential (E/sub p/). The occurrence of this transitional behavior is insensitive to alloy composition (apart from Cr) and is probably almost independent of temperature. This suggests that the geometrical arrangement of Cr atoms in the lattice is important for passivation, independent of other factors. The most important geometrical consideration in this problem is the degree of connectivity of Cr atoms through the three-dimensional (3D) lattice, ;which is described by percolation theory. Percolation processes characteristically show a sharp threshold (p/sub c/) which represents the concentration of occupied sites (or bonds) at which a connected cluster of "infinite" extent suddenly appears.

11649 Sound speed in liquid lead at high temperatures. Hixson, R.S.; Shaner, J.W.; Winkler, M.A. (Los Alamos National Lab., Los Alamos, NM). *International Journal of Thermophysics;* 7: No. 1, 161-165(Jan 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

A dynamic technique, the isobaric expansion experiment (IEX), is used to reach high-temperature and pressure states in liquid lead. A unique technique is described for making sound-speed measurements once a final equilibrium end state is obtained. Data over an extended density range are presented. The sound speed in liquid lead over this range appears to vary linearly with density and has no dependence on temperature within our experimental precision (+/- 7%).

11650 Isothermal forging of HIP'ed superalloy. Takigawa, H.; Kawai, N.; Iwai, K. (Kobe Steel, Ltd., Japan). pp 497-508 of 1985 Annual Powder Metallurgy Conference, San Francisco, CA, July 14-17, 1985, Proceedings. Sanderow, H.I.; Giebelhausen, W.L.; Kulkarni, K.M. Princeton, NJ; Metal Powder Industries Federation (1986). (CONF-850791—).

From Annual powder metallurgy conference; San Francisco, CA, USA (14 Jul 1985).

IN100 superalloy powder was consolidated by HIP for isothermal, superplastic forging. As a result, a forging billet with adequate superplasticity was obtained by HIPing the powder at a temperature below gamma-prime solvus. The superplastic behavior of as-HIP'ed compacts was also examined at various temperatures and strain rates. The results showed that the strain in excess of 500 percent was achieved. Under these optimum conditions, subscale disks were forged superplastically to near-net shape. The effect of solution heat treatment after isothermal forging was studied for fine grained IN100 forgings. The results showed that the properties of creep rupture and low cycle fatigue were improved by high temperature heat treatment. Tensile, creep rupture and low cycle fatigue tests were also carried out on specimens removed from as-HIP and HIP + isothermal forged disk heat treated under the above optimum conditions. As a result, no differences were found between both materials except in tensile ductility. 6 references.

11651 Corrosion evaluation of alloys for nuclear waste processing. Corbett, R.A.; Bickford, D.F.; Morrison, W.S. (E.I. du Pont de Nemours & Co., Engineering Dept., Wilmington, DE 19898). pp 1-16 of Proceedings of the technical symposium of Corrosion 86. Houston, TX; National Association of Corrosion Engineers (1986). (CONF-860304—).

From Corrosion '86; Houston, TX, USA (17 Mar 1986).

This paper describes a research program of stress corrosion cracking (SCC) of Inconel Alloys 600 and 690 in all-volatile treated (AVT) water. Specimens of Alloys 600 and 690 were exposed to AVT water at 288°, 332°, 343°, and 360°C. Alloy 600 generally resists SCC in high-purity water under normal service conditions but is susceptible under other specific conditions. In general, mill-annealed Alloy 600 is more susceptible than stress-relieved material. Susceptibility to SCC increases rapidly with increasing exposure temperature. Very high stresses (near or above yield) are required to induce cracking in AVT or other high-purity waters. Most of the data obtained in this research effort were for Alloy 600; Alloy 690 did not fail by SCC.

11652 Corrosion processes of austenitic stainless steels and copper-based materials in gamma-irradiated aqueous environments. Glass, R.S.; Van Konynenberg, R.A.; Overturf, G.E. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 1-12 of Proceedings of the technical symposium of Corrosion 86. Houston, TX; National Association of Corrosion Engineers (1986). (CONF-860304—). Contract W-7405-ENG-48.

From Corrosion '86; Houston, TX, USA (17 Mar 1986).

The U.S. Department of Energy is evaluating a site located at Yucca Mountain in Nye County, Nevada, as a potential high-level nuclear waste repository. The rock at the proposed repository horizon (above the water table) is densely welded, devitrified tuff, and the fluid environment in the repository is expected to be primarily air-steam. A more severe environment would be present in the unlikely case of intrusion of vadose groundwater into the repository site. For this repository location, austenitic stainless steels and copper-based materials are under consideration for waste container fabrication. This study focuses on the effects of gamma irradiation on the electrochemical mechanisms of corrosion for the prospective waste container materials. The radiolytic production of such species as hydrogen peroxide and nitric acid are shown to exert an influence on corrosion mechanisms and kinetics.

11653 Measurement and prediction of thermomechanical history effects on sensitization development in austenitic stainless steels. Bruemmer, S.M.; Charlot, L.A. (Pacific Northwest Lab., Richland, WA 99352). pp 1-18 of Proceedings of the technical symposium of Corrosion 86. Houston, TX; National Association of Corrosion Engineers (1986). (CONF-860304—). Contract AC06-76RL01830.

From Corrosion '86; Houston, TX, USA (17 Mar 1986).

The effects of thermal and thermomechanical treatments on sensitization development in Type 304 and 316 stainless steels have been measured and compared to model predictions. Sensitization development resulting from isothermal, continuous cooling and pipe welding treatments has been evaluated. An empirically-modified, theoretically-based model is shown to accurately predict material degree of sensitization (DOS) as expressed by the electrochemical potentiokinetic reactivation (EPR) test after both simple and complex treatments. Material DOS is also examined using analytical electron microscopy to document grain boundary chromium depletion and is compared to EPR test results.

11654 Tritium in Pd and Pd /SUB 0.80/ Ag /SUB 0.20/ . Lasser, R.; Powell, G.L. (KernForschungsanlage, Jo'lich). pp 387-396 of Hydrogen in disordered and amorphous solids. Bambakidis, G; Bouman, R.C. New York, NY; Plenum Press (1986). (CONF-8509318—).

From Fundamentals of natural gas regulation: short course for energy users; Washington, DC, USA (18 Nov 1986).

Solubility measurements of H, D and T in Pd and Pd /SUB 0.80/ Ag /SUB 0.20/ have been performed in a very large temperature range. A simple analytical expression is given for the equilibrium constants which describes the equilibrium between the hydrogen atoms dissolved in a metal at infinite dilution and the hydrogen molecules in the gas phase. From this expression the partial enthalpies and entropies of H, D, T in metals can easily be calculated. Also the vibrational ground state energies of H, D and T in Pd and Pd /SUB 0.80/ Ag /SUB 0.20/ relative to the energy of atomic hydrogen at rest could be determined accurately. In addition, the isotopic dependence of the phase boundaries in Pd will be discussed.

11655 Deuteron magnetic resonance in some amorphous semiconductors. Bork, V.P.; Fedders, P.A.; Leopold, D.J.; Norberg, R.E. (Washington Univ., St. Louis, MO). pp v. of Hydrogen in disordered and amorphous solids. Bambakidis, G.; Bowman, R.C. New York, NY; Plenum Press (1986). (CONF-8509318—).

From Fundamentals of natural gas regulation: short course for energy users; Washington, DC, USA (18 Nov 1986).

Deuteron magnetic resonance (DMR) measurements have been made on plasma-deposited samples of a-Ge:D,H; a-Si:D,F; and a-SiGe:D,F. The experiments were performed at 30.7 MHz with a Bruker CXP 200 spectrometer nad a probe constructed to permit operation at high rf power down to temperatures near 4 K. Spin-lattice relaxation times (T_1 were obtained by the saturation-recovery method and trnasverse relaxation times were measured directly from the Lorentzian line shapes. Some details of the sample preparations and the DMR spin counts are listed. Two Xerox PARC a-Si:D,H samples for which DMR results have been reported are presented. The three-digit numbers for the other materials are Harvard sample designators.

11656 High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). 569p. (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

The papers presented in this volume provide an overview of recent theoretical and experimental research in the chemistry, physical metallurgy, and mechanical behavior of high-temperature ordered intermetallic alloys. Topics discussed include interatomic interactions in transition and noble metal alloys and the stability of the ordered state; microstructures in rapidly solidified L1(2)-type Ni-Al-Cr alloys; plastic flow of L1(2) ordered alloys; and hydrogen embrittlement of ordered alloys. Papers are also presented on the characteristic mechanical properties and phase stability of L1(2) intermetallic compounds, creep in ordered nickel base alloys, and the B2 aluminides as alternative materials.

11657 Modulated microstructures in beta-phase alloys. Wayman, C.M. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 77-91 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

Many ordered beta-phase alloys of the B2 or DO3 types exibit unusual diffraction patterns and images when examined in the transmission electron microscope. These effects include extra diffraction spots, diffuse scattering, satellites, tweed microstructures, spinodal decomposition and the formation of incommensurate phases. Examples of these phenomena are presented and discussed. Although most of the beta-alloys also undergo a martensitic transformation at some lower temperature, it is argued that the above effects are not premartensitic or precursory in nature. However, many of them can be related to certain properties of the beta-phase such as elastic anisotropy, a soft phonon mode, and electronically driven instabilities. 23 references.

11658 Kinetics of the SRO-LRO transformation in NI4MO. Star bury, E.E. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 93-107 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

The isothermal time-temperature dependence of the transformation from SRO to LRO as measured by resistivity changes is given. Problems of defining an initial state from which the transformation occurs are reviewed with emphasis on the microdomain structure from which the LRO structure develops. Questions of homogeneous transformation relative to heterogeneous transformation by clear nucleation and growth are addressed in terms of experimental evidence and theoretical predictions. Strong evidence for a nucleation and growth mechanism, at least above 750 C, is presented. 37 references.

11659 Resistivity of short-range and long-range order changes in Ni4Mo. Lei, T.S.; Vasudevan, K.; Stansbury, E.E. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 163-172 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

Short-range order (SRO) and long-range order (LRO) reactions in Ni4Mo as a function of room temperature deformation and thermal treatments between -269 and 1300 C are reported. Resistivity results show that SRO is dispersed by heating near 1300 C and by cold working to 68 percent reduction of area (RA). The resistivity decreases to a minimum at 68 percent RA after which an increase is attributed to an increase in defect density. The resistivity as a function of variations in the time-temperature history is reported. Cooling at 60 C/min results in the maximum frozen in SRO with resistivity of 144 microohm cm at 25 C; the resistivity of the LRO state obtained on slow cooling is 48 microohm cm. At -269 C, the resistivities are 139 and 8 microohm cm for the SRO and LRO states respectively. Correlations relate kinetics and microstructures to resistivity changes during heating, cooling and isothermal SRO-LRO transformations. Preliminary results of reheating fully ordered samples to near 868 C and quenching are reported. Results are discussed with relevance to existing theories. 55 references.

11660 Creep in ordered nickel base alloys. Strutt, P.R.; Kear, B.H. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 279-292 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

This paper examines the fundamentals of deformation behavior in ordered gamma prime (Ni_3Al), beta (NiAl) and beta prime (Ni_2AlTi) phases, and specific two phase gamma/gamma prime and beta/beta prime alloys. The relative creep strengths of these ordered nickel-base alloys are discussed. Differences in creep behavior are explained in terms of the effects of temperature, crystallographic orientation and alloying on creep deformation mode. In particular, it is shown that trace additions of boron and carbon to gamma/gamma prime alloys, or deviations from stoichiometry in beta-prime-type alloys can exert a strong influence on creep behavior. 20 references.

11661 High temperature properties of equiatomic FeAl with ternary additions. Titran, R.H.; Vedula, K.M.; Anderson, G.G. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 309-317 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

The aluminide intermetallic compounds are considered potential structural materials for aerospace applications. The B2 binary aluminide FeAl has a melting point in excess of 1500 K, is of simple cubic structure, exists over a wide range of composition with solubility for third elements and is potentially self-protecting in extreme environments. The B2 FeAl compound has been alloyed with 1 to 5 at. pct ternary additions of Si, Ti, Zr, Hf, Cr, Ni, Co,

Nb, Ta, Mo, W, and Re. The alloys were prepared by blending a third elemental powder with pre-alloyed binary FeAl powder. Consolidation was by hot extrusion at 1250 K. Annealing studies on the extruded rods showed that the third element addition can be classified into three categories based upon the amount of homogenization and the extent of solid solutioning. Constant strain rate compression tests were performed to determine the flow stress as a function of temperature and composition. The mechanical strength behavior was dependent upon the third element homogenization classification. 15 references.

11662 **Effect of surface oxide films on the mechanical behavior of NiAl.** Noebe, R.D.; Gibala, R. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 319-326 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

Experiments have been carried out on impure nonstoichiometric NiAl (47.1 at. pct Al) single crystals to examine possible effects of surface film on the mechanical behavior of B2 ordered intermetallic alloys. It is found that the flow stresses for oxide-coated crystals are as much as 20 percent lower than those for identically prepared uncoated specimens. The strains to fracture for coated specimens are larger than those for uncoated crystals, the ductility enhancement being as much as a factor of four in a few instances. The largest softening effect has been observed for a 350-nm delta-Al_2O_3 oxide coating deposited at 1000 C. Experiments are suggested which could further enhance the film softening effects observed in B2 ordered intermetallic alloys. 50 references.

11663 **Creep behavior of the ordered intermetallic (Fe,Ni)Al phase.** Rudy, M.; Sauthoff, G. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 327-333 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

The deformation behavior of the ordered intermetallic (Fe,Ni)Al phase with B2 structure is studied as a function of composition and temperature with stress strain tests and creep tests. The alloy composition has been varied with respect to stoichiometry and the Fe/Ni ratio. The creep resistivity depends on the alloy composition in a complex manner: a deviation from the stoichiometric compositions leads to a reduction of the creep resistance, and there is a maximum of the creep resistance for the ternary alloys with about 10 percent Fe. 14 references.

11664 **Property comparison of melt-spun ribbons and consolidated powders of Ni3Al-B.** Chang, K.-M.; Taub, A.J.; Huang, S.C. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 335-342 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

Ductile intermetallic Ni_3Al-B alloys have been processed through three rapid solidification techniques: melt spinning, gas atomization, and plasma deposition. Different thermal treatment was required for each rapidly solidified product in form samples for mechanical evaluation. Melt-spun ribbons were tested in ribbon form in the as-cast or annealed conditions, while atomized powders were tested after consolidation by hot isostatic pressing (HIP) or low pressure plasma deposition. Alloy strength, as well as tensile ductility, was found to depend strongly on processing technique, thermal treatment, sample geometry, and most importantly, alloy chemistry. Microstructural and fractographic observations indicate that grain boundary brittleness caused by material processing history plays the major role in determining the alloy's mechanical behavior. 11 references.

11665 **B2 aluminides as alternative materials.** Stephens, J.R. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 381-395 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

The potential of the B2 aluminides as structural material alternatives for the strategic element containing superalloys currently used in gas turbine engines is being explored with emphasis on the equiatomic Fe and Ni aluminides. Although Co is a strategic material, the equiatomic Co aluminide is also being studied to gain a more complete understanding of these fourth period intermetallics. Research focuses on initial processing techniques such as ingot melting, power metallurgy, and rapid solidification with and without additional thermomechanical processing; high temperature deformation primarily compreasive creep; compositional effects within the binary B2 aluminides; third-element alloying addition effects on high temperature strength and oxidation resistance, and near room temperature ductility as influenced by processing, alloying, and grain size. Various programs now underway are reviewed and some highlights of research results are presented. 33 references.

11666 **Ni-base intermetallics for high temperature alloy design.** Nash, P. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 423-427 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

Further development of Ni-base superalloys based on gamma-gamma prime structures offers little hope of substantial improvements in properties for gas turbine applications. However, because of the substantial technology base which exists for nickel base alloys there are considerable advantages, in research time and money, in developing new nickel base alloys. Interest in the 1970s in directionally solidified composites indicated some possible new systems to replace gamma-gamma prime alloys. More recently there has been renewed interest in aluminides such as FeAl, CoAl and NiAl. These materials exhibit melting points which are substantially greater than for current gamma-gamma prime alloys. Problems of lack of ductility for these alloys may be resolved by alloying and novel processing routes such as rapid solidification. In addition to NiAl there are a number of other nickel intermetallics which from limited experimental data are worth considering at least as second phases. Some of these compounds are Ni7Hf2, Ni7Zr2, Ni5Zr, Ni6AlTa, and Heusler alloys of the type NiAl(x) where x is a transition element. The solubilities and phase relationships and where available the mechanical property data in a number of nickel ternary systems will be reviewed in terms of their potential for development of new high temperature alloys. 15 references.

11667 **High temperature oxidation of beta-NiAl.** Koychak, J.K.; Mitchell, T.E.; Smialek, J.L. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 475-484 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

The oxidation of single crystal beta-NiAl has been studied primarily using electron microscopy. Oriented metastable Al_2O_3 phases form during transient oxidation at 800 C. Specific orientation relationships exist on all metal orientations studied and are a result of the small mismatch along aligned close-packed directions

in the cation sublattices of the metal and oxide. Transformation of the metastable Al_2O_3 phases at 1100 C results in an oxide morphology described as the lacey structure of alpha-Al_2O_3 scales. This structure results from impingement of oriented patches of alpha-Al_2O_3 as the transformation initiates and moves radially parallel to the surface. Scale growth occurs by diffusion along high angle grain boundaries. A drastic reduction in oxidation rate accompanies the change in oxide morphology. 18 references.

11668 **Ordering behavior and corrosion properties of Ni-Mo and Ni-Mo-Cr alloys.** Tawancy, H.M.; Asphahani, A.I. (North Carolina State Univ., Raleigh; Oak Ridge National Lab., TN; Rensselaer Polytechnic Institute, Troy, NY). pp 485-494 of High-temperature ordered intermetallic alloys; Proceedings of the Symposium, Boston, MA, November 26-28, 1984. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411198—).

From Symposium on high temperature intermetallic compounds; Boston, MA, USA (26 Nov 1984).

Ni-Mo alloys containing 26-28 wt. pct Mo are known for their excellent corrosion properties in reducing environments. When exposed to temperatures in the range 600 C to 800 C, however, these alloys undergo a long-range ordering reaction from disordered fcc lattice to ordered D1(a) superlattice. This ordering phenomenon has been found to have detrimental effects on corrosion properties. Also, alloys based on the Ni-^{16}Mo-^{16}Cr system undergo a long range ordering reaction from disordered fcc lattice to ordered Pt2Mo-type superlattice in the temperature range of 400 to 600 C. However, in contrast to the case of Ni-Mo alloys, ordering in the Ni-Mo-Cr alloys has some beneficial effects on the aqueous corrosion properties. This difference in behavior between the Ni-Mo alloys and the Ni-Mo-Cr alloys is discussed in terms of the ordering characteristics determined from transmission electron microscopy and diffraction, X-ray microanalysis in the scanning transmission electron microscope and Auger electron spectroscopy. 11 references.

11669 **Importance of surface structure in electrochemistry: the well-defined Au (111) single crystal electrode surface.** D'Agostino, A.T.; Ross, P.N. Jr. (Lawrence Berkeley Lab., CA). *Journal of Electroanalytical Chemistry;* **189**: 371-377(1985). Contract AC03-76SF00098.

In this communication, they report observations of the UHV (ultra-high vacuum) structure of Au (111) crystals prepared in their laboratory, the characteristic voltammetry for this surface, and the stability of the UHV structure to anodic cycling. They show that it can be very difficult to obtain a well-defined surface structure on Au (111) crystals, and they suggest that most reports with Au single crystals that have appeared in the literature cannot be regarded as representative of known (well-defined) surface structures.

11670 **AES and TDS studies of electrochemically oxidized Pt(100).** Wagner, F.T.; Ross, P.N. Jr. (Lawrence Berkeley Lab., CA). *Applications of Surface Science;* **24**: 87-107(1985). Contract AC03-76SF00098.

Anodic films formed on Pt(100) in 0.3 M HF using a quasi thin-layer electrochemical cell within a vacuum envelope were transferred to ultra-high vacuum for study by AES and TDS. Films generated at potentials above 1.1 V (RHE) survived immersion and pumpdown in a hydrated state. As the immersion potential increased, the integrated H_2O and O_2 thermal desorption signals increased in parallel, indicating a constant stoichiometry consistent with the formation of a platinum hydroxide layer. The oxygen TDS and AES signals after holding the electrode at constant potentials above 1.9 V (RHE) for several minutes saturated with formation of a surface phase containing 2.3 O/Pt (desorbing as O_2) and 2 H_2O/Pt. Much thicker films could be grown by AC polarization. XPS analysis combined with TDS indicated the most likely chemical state of the saturation layer to be $Pt(OH)_4$. Water evolved from all films at 400 K and higher, temperatures much higher than that reported for surface adsorbed hydroxyl groups produced by low-temperature gas-phase coadsorption of O_2 and h_2O. The higher temperature desorption is ascribed to the incorporation of hydroxyls into a surface phase involving place-exchange between Pt and OH.

11671 **LEED spot profile analysis of the structure of electrochemically treated Pt(100) and Pt(111) surfaces.** Wagner, F.T.; Ross, P.N. Jr. (Lawrence Berkeley Lab., CA). *Surface Science;* **160**: 305-330(1985). Contract AC03-76SF00098.

The structures formed by oxidation-reduction cycling of ordering Pt(100) and Pt(111) surfaces in aqueous electrolytes were studied using LEED spot profile analysis. Surfaces cycled to anodic potential limits above 1.0 V (RHE) and immersed at 0.5 V gave LEED spots which varied in width periodically with beam energy. The varying spot widths indicated a type of randomly stepped surface, and mean terrace widths were estimated by comparison with the previously published scattering calculations of Henzler and Lu and Lagally. LEED spots from surfaces cycled to potentials below 1.0 V (RHE) remained sharp at all beam energies. The restructuring resulted from the anodic formation of an amorphous surface oxide phase involving place exchange of platinum and oxygen followed by a reduction process in which the platinum atoms do not all return to their original positions in the surface lattice. The observed spot profiles changed both with the number of cycles and with the upper potential limit. Cycling to 1.28-1.58 V produced characteristically different structures than cycling to limits of 1.08-1.28 V. At the higher potentials, a randomly-stepped surface was formed whose mean terrace width and extent of vertical relief were functions of the total anodic charge. Cycling to the lower potential limits produced a type of structure which is intermediate between the classical two-level island and the multi-level randomly-stepped structure. A three-level structure with a high degree of correlation between the first (island-like) and third (hole-like) levels is proposed for the latter.

11672 **Rapidly solidified prealloyed powders by laser spin atomization.** Konitzer, D.G.; Walters, K.W.; Heiser, E.L.; Fraser, H.L. (Univ. of Illinois, Urbana). *Metallurgical Transactions,* [*Section*] *B: Process Metallurgy;* **15B**: 149-153(Mar 1984). Contract AC02-76ER01198.

A new technique, termed laser spin atomization, for the production of rapidly solidified prealloyed powders is described. The results of experiments involving the production of powders of two alloys, one based on Ni, the other on Ti, are presented. The powders have been characterized using light optical metallography, scanning electron microscopy, energy dispersive x-ray spectroscopy, and Auger electron spectroscopy, and these various observations are described. 8 references, 8 figures.

11673 **Role of niobium in a dual-phase steel.** Guimaraees, J.R.C.; Chawla, K.K.; Rios, P.R.; Rigsbee, J.M. (Companhia Brasileira de Metalurgia e Mineracao, Sao Paulo). *Metals Technology;* **11**: 1-6(Jan 1984). Contract AC02-76ER01198.

Two hot-rolled high-strength, low-alloy steels, one microalloyed with niobium, were intercritically annealed at 740°C for 10 min and cooled to produce a dual-phase microstructure. Although both steels showed tensile properties typical of dual-phase microstructures, only the niobium-microalloyed steel could match the mechanical characteristics of a typical commercial dual-phase steel. The role of the niobium would appear to be to provide a suitable level of strength in the initial, as-rolled state of the steel, since the properties in the dual-phase state were found to be a function of the initial state of the steel. A normalizing treatment resulted in grain refinement in both steels, but transmission electron microscopy observations showed that in the niobium-containing steel this was counterbalanced by an increase in Nb (C, N) precipitate size. The normalizing treatment thus equalized the mechanical properties of the initial state of the two steels, leading to similar dual-phase properties in both cases; this observation confirms the importance of the initial state of the steel in obtaining a desirable set of mechanical properties after intercritical treatment. Of course, this initial state could be obtained in a number of ways, and microalloying with niobium represents only one such way. 16 references, 5 figures, 7 tables.

11674 Stress effects on Raman measurements of pulsed laser annealed silicon. Jellison, G.E. Jr.; Wood, R.F. (Oak Ridge National Lab., TN). *Materials Research Society Symposia Proceedings;* **23**: 153-158(1984). Contract W-7405-ENG-26.

It has recently been shown that the front surface region of the silicon lattice is severely strained during pulsed laser irradiation. This uniaxial strain reduces the symmetry of the front surface region, resulting in additional shifts and splittings of the phonon frequency and changes in the Raman scattering tensor. It is shown that, for the case of pulsed laser irradiation, the phonon frequency is increased, and the 3-fold degenerate optical phonon is split into a singlet and a doublet. The changes in the Raman scattering tensor make it non-symmetric, and generally invalidate the technique used by Compaan et al. to determine the cross section experimentally. The complications introduced by the presence of stress during pulsed laser annealing, coupled with the temperature dependence of the optical and Raman tensors, make a simple interpretation of the Stokes to anti-Stokes ratio in terms of lattice temperature extremely unreliable. 19 references, 1 figure.

11675 Effect of n-implantation on the corrosive-wear properties of surgical Ti-6Al-4V alloy. Williams, J.M.; Beardsley, G.M.; Buchanan, R.A.; Bacon, R.K. (Oak Ridge National Lab., TN). *Materials Research Society Symposia Proceedings;* **27**: 735-740(1984). Contract W-7405-ENG-26.

The effects of N-ion implantation on the corrosive-wear properties of Ti-6Al-4V, an alloy used for construction of the femoral component of artificial hip joints in humans, were tested. In corrosive-wear tests designed to simulate pertinent hip-joint parameters, electrochemical corrosion currents were measured for cylindrical samples in saline electrolyte in an arrangement which allowed the samples to be rotated between loaded polyethylene pads simultaneously with the current measurement. To further quantify material removal, Zr markers were ion-implanted into some samples so that, by use of Rutherford backscattering, material removal could be detected by changes in position of the marker relative to the surface. Corrosion currents were greatly reduced by implantation of approximately 20 at. % N, but even implantation of the Zr markers also reduced corrosion currents. The marker experiments confirmed the low rate of material removal for the implanted samples. 10 references, 5 figures, 1 table.

11676 Ordering of vacancies in LiAl. Brun, T.O.; Susman, S.; Dejus, R.; Graneli, B.; Skoeld, K. (Argonne National Lab., IL). *Solid State Communications;* **45**: No. 8, 721-724(1983).

The intermetallic compound β-LiAl contains relatively high concentrations of constitutional vacancies on the Li sublattice for Li deficient compositions. Neutron diffraction measurements on a Li/sub 0.486/Al/sub 0.514/single crystal show that these vacancies order on every tenth (840) plane at 97 K. This vacancy ordering is responsible for the 100 K anomaly observed in several physical properties. 10 references, 5 figures.

11677 X-ray study of xenon to 23 GPa. Schiferl, D.; Mills, R.L.; Trimmer, L.E. (Los Alamos National Lab., NM). *Solid State Communications;* **46**: No. 11, 783-785(1983).

X-ray diffraction photographs of polycrystalline xenon in a diamond-anvil cell show that the crystal structure of Xe remains fcc up to at least 23 GPa at 298 K. The atomic volumes are in good agreement with earlier x-ray data at lower pressures and with calculated volumes along the O-K isotherm. 25 references, 1 figure.

11678 Use of time-of-flight neutron diffraction to study grain interaction stresses. MacEwen, S.R.; Faber, J. Jr.; Turner, A.P.L. (Argonne National Lab., IL). *Acta Metallurgica;* **31**: No. 5, 657-676(1983).

Time-of-flight neutron diffraction, using the General Purpose Powder Diffractometer at the IPNS (Intense Pulsed Neutron Source) at the Argonne National Laboratory, has been used to measure residual stresses in deformed, polycrystalline Zircaloy-2. It was found that a plastic tensile strain of 3% caused the (1010) and (1120) prism lines in the diffraction pattern to shift to higher d-spacings, while the (0002) basal line was shifted to a lower interplanar spacing. Compressive deformation reversed the direction of the shifts, with the prism and basal planes being left in residual compression and tension respectively. The magnitude and sign of the residual stresses, which result from the interaction among the grains in the deforming polycrystalline specimen, are consistent with the texture and anisotropic yield surface of Zircaloy. For the specimen deformed to 424 MPa in tension, the principal residual stresses after unloading were - 188 MPa in the <c> direction and 173 MPa in the direction normal to the prism planes. The result is in good agreement with an analysis of the problem that considers an idealized texture that is representative of that found in Zircaloy-2 rod. The experiments demonstrate that time-of-flight neutron diffraction can be a sensitive and powerful tool for measuring residual stresses in bulk materials, where conventional X-ray techniques would be inapplicable. 48 references, 14 figures, 7 tables.

11679 Performance of mechanical scraping tools in ultra-high vacuum: an XPS study. Lazarus, M.S.; Sham, T.K. (City Univ. of New York, Bronx). *Journal of Electron Spectroscopy and Related Phenomena;* **31**: 91-96(1983).

In order to carry out meaningful photoelectron measurements of the chemical composition of a solid, it is a common practice to clean the surface so that surface contamination is minimized. Among the various methods that have been employed in the cleaning of surfaces, the popular ones are (1) ion-gun sputtering, (2) heating in ultrahigh vacuum, (3) fracturing of materials, (4) direct evaporation of metal onto inactive backings, and (5) scraping of materials. Of these methods, the ion-sputtering technique is the most popular. Method (2) is often used in conjunction with method (1). Methods (3) and (4) are limited to materials that can be easily cleaved or evaporated, respectively. The scraping technique, the applicability of which had been demonstrated in the early development (1) of the ESCA technique, has received relatively little attention. It is the purpose of this article to examine some of the considerations to be borne in mind when cleaning a sample surface, with emphasis on the scraping technique. In particular, comparisons are made between mechanically scraped surfaces and Ar^+-etched surfaces of two materials. The importance of choosing the best scraping device for a particular surface is discussed. In general, they conclude that it is better to scrape the surface than to Ar^+-etch it.

11680 Superconductivity in rapidly quenched Mo-P-B alloys. Koch, C.C.; Scarbrough, J.O.; Kroeger, D.M.; Easton, D.S. (Oak Ridge National Lab., TN). *Journal of Materials Science;* **18**: 759-765(1983). Contract W-7405-ENG-26.

Superconducting transition temperatures (T/sub c/) were measured for a series of Mo-P-B alloys in the Mo-rich corner of the ternary system. The alloys were studied in two forms: (a) slowly cooled after induction melting, and (b) rapidly quenched in an arc hammer apparatus. The rapid quenching produced an amorphous structure, but most of the alloys also contained some crystalline material, indicating that this system is not conducive to easy glass formation. Ternary slowly cooled crystalline alloys in the concentration range 20 to 30 at% phosphorus and 10 to 20 at% boron had relatively high T/sub c/ values of 9.6 to 9.9 K; higher than for either the Mo-P or Mo-B binary systems. T/sub c/ values up to 9.02 K were observed for completely amorphous foils, consistent with the previously reported maximum T/sub c/ values for amorphous alloys in this system. This remains the highest T/sub c/ reported for a metallic glass. All of the rapidly quenched foils were brittle. 25 references, 3 figures, 1 table.

11681 Electronic resistivity and defect structure of β-LiAl as a function of temperature and composition. Hall, L.N.; Brun, T.O.; Crabtree, G.W.; Robinson, J.E.; Susman, S.; Tokuhiro, T. (Argonne National Lab., IL). *Solid State Communications;* **48**: No. 6, 547-549(1983).

The electrical resistivity of β-Li/sub x/Al/sub 1-x/ has been measured from 10 K to 290 K in single crystal samples for four different concentrations, x = 0.480, 0.486, 0.500 and 0.525. An anomaly at 100 K is observed for the three lowest Li concentrations. This anomaly is associated with an ordering of constitutional Li vacancies. Above 100 K the temperature dependent part of the resistivity is independent of the Li concentration. However, the residual resistivity increases very rapidly with increasing Li concentration, be-

coming ~ 75 μOmega-cm for x = 0.525. These results suggest that the two defect model of β-LiAl may be incomplete. 14 references, 3 figures, 1 table.

11682 **Deep level effects in silicon and germanium after plasma hydrogenation.** Pearton, S.J.; Kahn, J.M.; Haller, E.E. (Lawrence Berkeley Lab., CA). *Journal of Electronic Materials;* **12**: No. 6, 1003-1014(1983). Contract AC03-76SF00098.

Deep level electron and hole trapping states are observed in n- and p-type silicon after plasma hydrogenation at 250 - 300°C. These defect states are not observed after exposure to a helium plasma. In contrast to these results, no hydrogen or helium plasma-induced levels are seen in n- or p-type germanium after similar heat treatment of up to 600°C. However, hydrogenation of p-type germanium at 600°C significantly enhances the solubility of the rapidly diffusing impurity copper, compared to untreated material. Reproducing the experiments using a helium plasma does not affect the copper solubility. A simple model which accounts for the experimental results is proposed. 18 references, 6 figures.

11683 **Role of surface processes in the gaseous hydrogen embrittlement of steels.** Pasco, R.W.; Sieradzki, K.; Ficalora, P.J. (IBM, Hopewell Junction, NY). pp 375-381 of Embrittlement by the localized crack environment. Gangloff, R.P. (ed.). Annandale, NJ; Exxon Research and Engineering Company (1983). Contract AC02-76CH00016.

From International symposium sponsored by the corrosion and environmental effects committee; Philadelphia, PA, USA (4-5 Oct 1983).

A brief overview of the gaseous hydrogen embrittlement (ghe) of iron-based alloys is presented. The central theme of the review is concerned with identifying the role of surface processes and exploiting this knowledge in the determination of bulk characteristic length scales associated with the phenomenon. In this regard, adsorption is shown to be the rate limiting process in ghe during Stage II crack growth in high strength steels. The authors also take this opportunity to clear up some misconceptions which have developed in the literature of this topic with regard to adsorption aspects of embrittlement. Here the authors consider the role of oxygen as an embrittling agent and limitations inherent in adsorption isotherms, often used in the calculation of reductions in surface free energy. Finally, the authors consider some related work which the authors hope serves to illuminate our approach in studying gaseous hydrogen embrittlement. 28 references.

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REFER ALSO TO CITATION(S) 10911, 11178, 11310, 11618, 11619, 11679, 11723, 11968, 11968, 11997, 12869, 12967

11684 **(AD-A—172642/1/XAB) Defect structure, ionic conductivity, and diffusion in yttria-stabilized zirconia and related oxide electrolytes with fluorite structure.** Nakamura; Wagner, J.B. (Arizona State Univ., Tempe (USA)). Aug 1986. 8p. NTIS, PC A02/MF A01.

Ionic conductivity data of yttria-stabilized zirconia, $Y_4xZr/sub 1-4/xO/sub 2-2x/$, reported in the literature as functions of oxygen vacancy concentration, x, and temperature, T, were analyzed according to a theoretical model developed in a previous paper and applied to calcia stabilized zirconia. Because of the different charge-compensation mechanism in yttria stabilized zirconia, $Y_4xZr/sub 1-4/xO/sub 2-2x/$, than that in calcia-stabilized zirconia, $Ca/sub 2x/Zr/sub 1-2x/O/sub 2-2x/$, the theory predicts the occurrence of a maximum of ionic conductivity at an oxygen vacancy concentration, which is just half the oxygen vacancy concentration at the maximum, x = 0.0625 (= 1/16), in calcia-stabilized zirconia. Results of the theoretical analysis on yttria-stabilized zirconia obtained herein are compared with those on calcia-stabilized zirconia obtained in Paper 1 and are also discussed in relation to the ionic conductivity data of the various rare earth oxide-stabilized zirconia systems. The basic assumptions and limitations of the theoretical model are critically examined, and possible modifications of the theoretical model are suggested.

11685 **(AD-A—173342/7/XAB) Processing science to increase the reliability of ceramics. Final report, 1 July 1984-31 March 1986.** Kellett, B.J.; Lange, F.F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Sep 1986. 122p. (SC—410.FR). NTIS, PC A06/MF A01.

Includes Technical Report Nos. 1 thru 4.

Contents include: thermodynamics of densification, Part I: sintering of simple particle arrays, equilibrium configurations, pore stability, and shrinkage; thermodynamics of densification, Part II: grain growth in porous compacts and relation to densification; thermodynamics of densification, Part III: experimental relation between grain growth and pore closure; and experiments on pore closure during hiping and forging.

11686 **(CONF-8608139—1) Deformation and oxygen diffusion in Mn/sub 1-δ/O.** Routbort, J.L.; Goretta, K.C. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87001520.

From Conference on non-stoichiometric compounds: the chemistry, physics and technological uses of non-stoichiometric compounds; Keele, UK (31 Aug 1986).

The steady-state flow stress of MnO single crystals has been measured from 900 to 1400°C over a wide range of oxygen partial pressures, p/sub O_2/, from 10^{-11} to 10^2 Pa. Diffusion of ^{18}O in MnO has been measured in the temperature range of 1100 to 1400°C at a p/sub O_2/ = 1 x 10^{-6} Pa. It has been firmly established that the recovery processes are controlled by dislocation climb which is governed by diffusion of anion defects. Vacancies or interstitials, whose charge depends on temperature, are operative depending on the p/sub O_2/. When the MnO data are compared with those of other isostructural nonstoichiometric oxides, a very consistent description of the relationship between the minority point defects and steady-state deformation emerges.

11687 **(DOE/ER/45202—2) Wetting and dispersion in ceramic/polymer melt injection molding systems: Progress report.** Sacks, M.D.; Williams, J.W.; Batich, C.D. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering). Nov 1986. Contract FG05-85ER45202. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003915.

Research progress is reported in the areas of rheological characterization, mixing/deagglomeration, ceramic/polymer interface modification, polymer matrix chemistry, and microstructure characterization. (DLC)

11688 **(SAND—86-2488C) Laser mapping of Al-h^+ impurity distribution in vacuum swept crystalline quartz.** Anthes, J.P.; Garcia, P.; Koehler, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 4p. (CONF-870220—4). NTIS, PC A02. File Number DE87003040.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

We have demonstrated that HeNe laser light absorption can be used to map the Al-h^+ impurity concentration distribution in vacuum swept cultured quartz.

11689 **Dehybridization of the 4f shell in Si-substituted $CeRh_3B_2$.** Malik, S.K.; Shenoy, G.K.; Dhar, S.K.; Paulose, P.L.; Vijayaraghavan, R. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review* [*Section*] *B: Condensed Matter;* **34**: No. 11, 8196-8198(1 Dec 1986).

The compound $CeRh_3B_2$ is known to order magnetically with an unusually high Curie temperature (T/sub C/) of 115 K and a low saturation moment of about 0.4μ/sub B/. We have studied the magnetic behavior of the system $CeRh_3(B/sub 1-//sub x/Si/sub x/)_2$ ($0 \leq x \leq 0.5$). It is observed that on partial replacement of B by Si an anisotropic lattice expansion takes place and the magnetic moment per Ce ion increases to more than 0.8μ/sub B/ but at the same time T/sub C/ shows a remarkable decrease by an order of magnitude to 16 K for $CeRh_3BSi$. These results suggest that the

anomalous behavior of $CeRh_3B_2$ arises because of the Ce 4f hybridization with the neighboring ligands.

11690 Particle erosion of yttria-stabilized zirconia porous coatings. Eaton, H.E.; Novak, R.C. *Materials and Components in Fossil Energy Applications;* No. 63, 1-2(1 Aug 1986).

From International conference on metallic coatings; San Diego, CA, USA (Apr 1986).

The use of plasma-sprayed porous ceramic coatings for protection against high heat fluxes (thermal barriers) and against high-temperature corrosion has caused considerable interest recently, especially in the gas turbine industry. Understanding the erosion behavior of these coatings is important if they are to be used in practical applications. The effects of coating microstructure, density, porosity morphology and strength on the erosion behavior and rates are of particular interest, because most investigations of erosion historically have been conducted on essentially fully dense solid bodies. The properties of these coatings were systematically varied in an effort to identify the key parameters that control erosion performance. The erosion rates were determined by exposing flat specimens to 27 μm alumina particles at an angle of incidence of 15 degrees and at a velocity of 244 m/sec (800 ft/sec). The specimen temperature was controlled at 1288°C by injecting the particles into the exhaust nozzle of an air/jet fuel burner. Results of the tests are discussed.

11691 Microstructure of lead-magnesium niobate ceramics. Goo, E.; Yamamoto, T.; Okazaki, K. (Lawrence Berkeley Lab., Berkeley, CA 94720). *Journal of the American Ceramic Society;* 69: No. 8, C188-C190(Aug 1986). Contract AC03-76SF00098.

Lead-magnesium niobate ceramics were processed with excess MgO and by precalcining MgO and Nb/sub 2/O/sub 5/. Transmission electron microscopy revealed submicrometer MgO inclusions in the perovskite phase. The pyrochlore phase exists as submicrometer rectangular crystals in an amorphous PbO matrix. The composition of the pyrochlore phase was calculated to be Pb/sub 2.25/Mg/sub 0.27/Nb/sub 1.79/O/sub 7/.

11692 Surface characterization of silicon nitride and silicon carbide powders. Rahaman, M.N.; Boiteux, Y.; DeJonghe, L.C. (Lawrence Berkeley Lab., Berkeley, CA 94720). *American Ceramic Society Bulletin;* 65: No. 8, 1171-1176(Aug 1986). Contract AC03-76SF00098.

The nature and composition of the surfaces of silicon nitride and silicon carbide powders were investigated using high voltage and high resolution transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), and secondary ion mass spectrometry (SIMS). An amorphous oxide (or oxygen-rich) layer, ≈3-5 nm thick, present on the powder surfaces forms strong bridges between particles. Both XPS and SIMS show that oxygen is the major impurity on the powder surfaces, but minor impurities such as chlorine, fluorine, carbon, iron and sodium are also revealed. The extent of the oxide layer was reduced substantially by washing the powder in anhydrous hydrofluoric acid or by treatment in an argon/hydrogen gas mixture at ≈1300°C. Surface treatment in the gas mixture did not cause further agglomeration of the powder.

11693 Establishment of accuracy limits and standards for comparative thermal conductivity measurements[1]. Hickoy, C.E.; McVey, D.F.; Miller, J.B.; Olson, L.O.; Silva, A.J. (Sandia Natl. Labs., Albuquerque, NM). *International Journal of Thermophysics;* 7: No. 4, 755-764(Jul 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

New techniques have been developed for reducing thermal conductivity data from thermal comparative measurements. The first of these techniques is based on making a Taylor-series expansion of the stack centerline temperature profile. The result is an expression giving the ratio of sample to reference conductivities at any temperature as a function of measured quantities, the stack thermocouple readings and stack element thicknesses. The conventional formula presently used to reduce comparative conductivity data is shown to be a special result of the general analysis. A second technique involves the use of linear least-squares (LS) techniques to derive both the sample and the reference conductivities from the measured data. The LS technique provides the coefficients for a polynomial temperature expansion of the reference and sample conductivities directly. Use of the new techniques is illustrated in a reduction of some comparative data on the conductivities of Pyrex 7740 and Pyroceram 9606. It is shown that a highly self-consistent pair of conductivity functions can be derived for these two commonly used reference materials if the conductivity vs temperature relation for Pyrex is modified slightly from its recommended value. The Pyroceram conductivity results from the comparative measurements are in good agreement with a conductivity derived from pulse diffusivity and differential scanning calorimetry measurements and also in good agreement with the recommended Pyroceram conductivity function.

11694 Deuteron magnetic resonance in a-Zr_3PdD /SUB 2.9/ . Bork, V.P.; Bowman, R.C.; Fedders, P.A.; Norberg, R.E.; Venturini, E.L. (Washington Univ., St. Louis, MO). pp 263-272 of Hydrogen in disordered and amorphous solids. Bambakidis, G.; Bowman, R.C. New York, NY; Plenum Press (1986). (CONF-8509318—).

From Fundamentals of natural gas regulation: short course for energy users; Washington, DC, USA (18 Nov 1986).

The temperature dependences of the deuteron magnetic resonance measurements at 30.7 MHz have been performed on an a-Zr_3PdD /SUB 2.9/ sample between 19 and 460 K. Transverse relaxation rates were measured form line shapes which were Gaussian in the rigid lattice and Lorentzian when well narrowed. Spin-lattice relaxation rates were obtained by the saturation-recovery method. The nuclear relaxation rates for protons and deuterons are presented. DMR measurements in a-Zr_3 OdD /SUB 2.9/ confirm the existence of different activation energies in different temperature regimes, first postulated from a-Zr_3PdH /SUB x/ results.

11695 Theory of electronic states in disordered alloy hydrides. Papaconstantopoulos, D.A.; Laufer, P.M.; Switendiik, A.C. (Naval Research Lab, Albuquerque, NM). pp v of Hydrogen in disordered and amorphous solids. Bambakidis, G.; Bownan, R.C. New York, NY; Plenum Press (1986). (CONF-8509318—).

From Fundamentals of natural gas regulation: short course for energy users; Washington, DC, USA (18 Nov 1986).

Band structure calculations of metal hydrides have provided understanding of the bonding characteristics of these materials and clarified the mechanisms involved in various physical properties such as superconductivity. Since the electronic structure of stoichiometric hydrides has been discussed extensively in the literature, in this article we will focus on the methodology and results of disordered hydrides. This disorder can occur on the metal site of the hydride by considering random substitutions of the host metal or on the hydrogen sublattice where vacancies appear. The theory that we use is based on the coherent potential approximation and proceeds as follows. Self-consistent band structure calculations of typical metal hydrides are performed by the augmented plane wave method. The results of these calculations are fitted to a tight-binding Hamiltonian using a Slater-Koster type of procedure. This Hamiltonian is then used in a tight-binding version of the coherent potential approximation which gives us the electronic densities of states for different metal and hydrogen compositions.

11696 Effect of capillarity and pore-size distributions on pore and cavity growth. Davanas, K.; Solomon, A.A. (Purdue Univ., School of Nuclear Engineering, West Lafayette, IN 47907). pp 139-156 of Fission product behavior in ceramic oxide fuel. Hastings, I.J. Columbus, OH; American Ceramic Society (1986). (CONF-850536—).

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

The significance of the effects of capillarity, state of stress, and internal pressure during pore growth in porous materials under externally applied stresses is investigated. When other stresses are small, surface-tension forces can be of significant influence. Therefore, conditions are identified, and proper formulations are developed, for the cases where capillarity effects are important and need to be considered. An analysis of the deformation of materials due to growth of internal pores with various size distributions is also pre-

sented. It is shown that the occurrence (due to the size differences) of ripening, or coarsening, of the pores tends to prolong their expected time-to-rupture. It is also shown that the discrepancies between experiments and models that visualize materials as having pores of a unique size cannot be attributed only to the error that is introduced by ignoring the ripening phenomenon (as a consequence of the equisized-pore assumption).

11697 **(LA-tr—86-40) The synthesis of ultrafine Si_3N_4 in a hybrid plasma.** Tani, Toshihiko; Yoshida, Toyonobu; Akashi, Kazuo. V *Yogyo Kyokai Shi ;* **94**: No. 1, 11-16(1986). Contract W-7405-ENG-36. 11p. NTIS MF A01; 2; GPO Dep. File Number DE87003944.

11698 **TiN/sub x/(0.6 < x < 1.2): atomic arrangements, electronic structure, and recent results on crystal growth and physical properties of epitaxial layers.** Sundgren, J.E.; Johansson, B.O.; Rockett, A.; Barnett, S.A.; Greene, J.E. (Linkoeping Univ., Sweden; Univ. of Illinois, Urbana). pp 95-115 of Physics and chemistry of protective coatings. Sproul, W.D.; Greene, J.E.; Thornton, J.A. (eds.). New York, NY; American Institute of Physics (1986). (CONF-8504259—). Contract AC02-76ER01198.

From Conference on physics and chemistry of protective coatings; Universal City, CA, USA (12 Apr 1985).

In this paper, the present understanding of the atomic structure, the electronic structure, and bonding configurations in TiN/sub x/ is discussed together with the results of recent experiments involving the growth and characterization of the first epitaxial TiN/sub x/ films. Hardness (H), resistivity (rho), temperature coefficient of resistance (TCR), and Hall effect measurements have been carried out on the single crystal layers in order to begin to establish a set of intrinsic properties for TiN films which can serve as a reference for comparing the results obtained from polycrystalline coatings. For stoichiometric TiN(111) films, H = 2300 kg mm^{-2}, rho(300K) = 18 $\mu\Omega$ cm. TCR = 6200 ppM K^{-1}, and the room temperature electron carrier concentration and mobility are 5 x 10^{22} cm^{-3} and 6.7 $cm^2 V^{-1} s^{-1}$. H for TiN(110) was found to be 2000 kg mm^{-2} while rho was essentially the same as for TiN(111). H decreased with decreasing N/Ti ratio and rho increased with both increasing and decreasing N/Ti ratios. The significance of these results are discussed in terms of the atomic and electronic structure of these materials. 43 refs., 14 figs.

11699 **Rate-controlled technique for calcining and drying.** Lackey, W.J.; Angelini, P.; Caputo, A.J.; DeVore, C.E.; McLaughlin, J.C.; Stinton, D.P.; Hutchens, R.E. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **67**: No. 6, C102-C104(Jun 1984). Contract W-7405-ENG-26.

To control ceramic drying and calcining operations, an approach that ensures uniform gas evolution was developed to prevent cracking on sudden release of gas. Instead of increasing temperature according to a present schedule, the output signal from a thermogravimetric analysis apparatus is used as input to a computer system which varies temperature as required to cause mass loss to follow a preselected schedule. Materials that cracked when processed conventionally were prepared crack-free by this procedure. 14 references, 2 figures.

11700 **Microscopy of SiC powders synthesized by reacting colloidal silica and pitch.** Harris, L.A.; Kennedy, C.R.; Wei, G.C.T.; Jeffers, F.P. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **67**: No. 6, C121-C124(Jun 1984). Contract W-7405-ENG-26.

From 85. annual meeting of the American Ceramic Society; Chicago IL, USA (24 Apr 1983).

Ultrafine SiC powders synthesized by reacting colloidal silica with petroleum pitch were characterized by optical and electron microscopy. Spherical agglomerates and unattached particles of SiC were observed in all products irrespective of synthesis conditions. The source of the spherical agglomerates of SiC particles was traced to the precursor mixture. 9 references, 8 figures.

11701 **Processing and microstructural characterization of TiB_2 liquid phase sintered with Ni and Ni_3Al.** Angelini, P.; Becher, P.F.; Bentley, J.; Finch, C.B.; Sklad, P.S. (Oak Ridge National Lab., TN). *Materials Research Society Symposia Proceedings;* **24**: 299-305(1984). Contract W-7405-ENG-26.

An Analytical Electron Microscopy investigation of TiB_2 hot-pressed and pressureless sintered with Ni revealed the presence of Ni_3B and tau intergranular phase, respectively. Convergent Beam Electron Diffraction (CBED) was used to crystal structure determination and compositions were determined by quantitative x-ray Energy Dispersive Spectroscopy (EDS) and Electron Energy Loss Spectroscopy (EELS). The phase analyses were compared with phase diagram data. An evaluation was also made of TiB_2 hot pressed with Ni_3Al. Quantitative EDS and EELS microanalysis indicated a Ni, Al type boride tau ($Cr_{23}C_6$ type) intergranular phase. 8 references, 4 figures.

11702 **High temperature guinier x-ray diffractometry for thermal expansion measurements in the hexagonal form of cordierite (2MgO2Al3″O3#5SiO3″).** Pressnall, J.S.; Fitzpatrick, J.J.; Predecki, P. (Univ. of Denver, CO). pp 397-404 of Advances in x-ray analysis. Volume 27. New York, NY; Plenum Publishing Corporation (1984). Contract AC02-81ER10896.

A computer-controlled high temperature Guinier diffractometer system for accurate determination of lattice thermal expansion is described. A critical test of the system using α-Al_2O_3 (0.3μ polishing alumina) showed close agreement with the single crystal expansion data of Wachtman et al. Lattice thermal expansion of cordierite doped with the following dopants: Ge^{+4}, P^{+5}, Zn^{+2}, Li^{+1} and Ca^{+2} was investigated. Of these the Li^{+1} at the 5% level (5% of Si^{+4} replaced by Li^{+1} + Al^{+3}) produced the largest decrease in mean lattice expansion.

11703 **Electron inelastic mean free path (IMFP) in single crystal BeO by Rutherford backscattering (RBS) and Auger electron spectroscopy (AES).** Fowler, D.E.; Gyulai, J.; Palmstrom, C. (Cornell Univ., Ithaca, NY). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **A1**: No. 2, 1021-1025(Apr-Jun 1983). Contract AC02-79ER10501.

Quantitative studies of oxidation kinetics by electron spectroscopies require knowledge of the IMFP of electrons in the oxide. In general, IMFP data for oxides are not available. A method is presented for the determination of the IMFP in beryllium oxide using RBS to determine the oxide thickness and AES to measure the chemically shifted Be Auger electron intensity from the BeO-covered surface and the unshifted signal from the Be substrate. Using the normal exponential attenuation relationship between material thickness and the AES signal passing through the material, an IMFP of 6.0 +/- 0.8 monolayers is determined for ~ 100 eV electrons in BeO. In these experiments the oxide was grown at a temperature (~ 700 K) which ensured a good single crystal epitaxy on the substrate. Because of this good structural characterization, the IMFP can be presented equally well in units of monolayers or in units of length. The accuracy of the method and its general applicability to other materials is discussed.

3606 Other Materials

REFER ALSO TO CITATION(S) 10913, 10925, 11044, 11047, 11421, 11500, 11520, 11520, 11630, 11631, 11647, 11687, 11689, 11925, 12216

11704 **(AD-A—172367/5/XAB) Evaluation of epoxy composites using photoacoustic Fourier transform infrared spectroscopy. Final report.** Sloan, J.M. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Jul 1986. 13p. (MTL-TR—86-29). NTIS, PC A02/MF A01.

Fourier-transform infrared spectroscopy (FT-IR) using a photoacoustic sampling cell was used to obtain high-quality infrared spectra of various fiber-reinforced epoxy composites and the corresponding resin matrixes. Photoacoustic spectroscopy (PAS) offers the advantages of having little or no sample preparation for

high-quality spectra to be obtained, and no alignment of the infrared incident beam is necessary. This makes PAS an ideal sampling method for in-field testing of composite laminates. The spectra revealed information on the degree of cure of the resin system by monitoring the 915/cm absorption band and the type of reinforcement material used (glass or Kevlar).

11705 **(AD-A—172751/0/XAB) Fiber-matrix interactions in carbon-fiber/cement matrix composites. Technical report.** Cranmer, D.C.; Speece, D.J. (Aerospace Corp., El Segundo, CA (USA). Materials Sciences Lab.). 25 Jul 1986. 22p. (TR—0086(6935-14)-1). NTIS, PC A02/MF A01.

An understanding of the nature of the interface between fiber and composite matrix is essential for development of ceramic-matrix and metal-matrix composites. It has been shown that the use of organometallic-based coatings on carbon fibers aids processing and improves properties in metal-matrix composites. This report deals with the use of similarly coated carbon fibers in various cement matrices. It describes the method of applying the coatings and the differences in the fiber-matrix interfacial region due to the use of different coatings. The tensile properties are discussed and related to the differences seen at the interface as well as to differences in processability.

11706 **(AD-A—172802/1/XAB) Sensitivity of polymer blends to synchrotron radiation. Technical note.** Jubinsky, J.A.; Groele, R.J.; Rodriquez, F.; Namaste, Y.M.; Obendorf, S.K. (Cornell Univ., Ithaca, NY (USA). School of Chemical Engineering). 26 Sep 1986. 25p. (TR—3). NTIS, PC A02/MF A01.

The sensitivity of poly(methylmethacrylate), PMMA, to x rays is enhanced by the addition of poly(epichlorohydrin), CO rubber. The two polymers appear to be miscible over a wide concentration range. Films with 20 to 50% CO in PMMA require only 1/2 to 1/4 the exposure dose of synchrotron radiation to produce an equivalent pattern in PMMA alone. The sensitivity is confirmed by measurements of molecular weight of blends irradiated by gamma rays or electrons, a well as x rays. Dissolution behavior of the blends also is similar to that for PMMA.

11707 **(AD-A—173509/1/XAB) Superconductivity of thin-film inatermetallic compounds. Annual technical report, 1 September 1985-31 August 1986.** Goldman, A.M. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 15 Sep 1986. 29p. NTIS, PC A03/MF A01.

Investigations of both the macroscopic and microscopic properties of thin-film superconducting materials are being carried out. Compounds under study are either technologically significant or involve possible unique mechanisms for superconductivity whose realization may extend the range of critical parameters. Under study are low-carrier-density superconductors, selected heavy fermion compounds and Chevrel-phase superconductors. High-quality superconducting films of both PbTe(Tl) and mixtures of La_2S_3-La_3S_4 were prepared. These materials are low-carrier-density superconductors. This work is an important step in the direction of fabricating three-terminal superconducting (FET-like) devices. Films of UPt_3 were produced that exhibit superconductivity. The goal of demonstrating the nature of superconducting pairing in this heavy fermion compound using tunneling and the proximity effect is in sight. Domain-wall superconductivity was demonstrated in the ferromagnetic phase of $HoMo_6S^8$, a Chevrel phase compound which is a reentrant superconductor.

11708 **(DOE/ER/45112—3) Experiments and micromechanical models for creep-rupture in polymer matrix composites: Progress report for period June 15, 1984-June 14, 1987.** Phoenix, S.L. (Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering). Dec 1986. Contract FG02-84ER45112. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003567.

The research thrust has been to develop micromechanical probability models and conduct critical experiments on the failure of polymer matrix composites under high, sustained loads. Tensile failure of such composites is a complex statistical process involving scattered failure of fibers at flaw sites, and local overloading and failure of neighboring fibers by way of stress transfer through the matrix which may creep and debond in time. Failure results from the subsequent development of a catastrophic crack. These models are ultimately to be used to develop life prediction methodologies, accelerated test techniques, and superior 'microengineered' composites. Recent theoretical progress has included a new recursive formulation which yields a key asymptotic scaling law for strength and lifetime; this is also a new development in modern percolation theory. A key characteristic distribution function results which embodies all local statistical and micromechanical activity, and is now amenable to 'supercomputer' calculation. Progress has also been made in developing a self-similar formulation for micromechanical stress redistribution under a power law creeping matrix. Experimental advances include creep-rupture results for single Kevlar 49 aramid fibers at elevated temperatures, creep-rupture results for graphite fiber/epoxy microcomposites, the development of a single fiber composite test as an advanced technique for studying statistics for fiber strength and fiber/matrix debonding, microindentation techniques for studying matrix creep and debonding, and the development of research equipment for high-precision fabrication of microcomposites.

11709 **(DOE/ER/45217—2) Mechanism of mechanical fatigue of fused silica: Progress report, January 1, 1986-November 30, 1986.** Tomozawa, Minoru. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). Dec 1986. Contract FG02-85ER45217. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003794.

The mechanical strength of glass is strongly influenced by crack geometry. A different fatigue mechanism has to be invoked depending upon whether the crack tip is sharp or blunt; a sharp tip crack can simply propagate, but a blunt tip crack has to be sharpened before it can propagate. It was shown that the crack tip of glass becomes blunt upon annealing. Similarly, the formation if a blunt crack was demonstrated earlier for glass specimens treated in hot water. Next, effects of the crack tip blunting on both dynamic fatigue and static fatigue were investigated in various liquids. It was found that fatigue of specimens with sharp cracks can be explained by the slow crack growth model satisfactorily, but fatigue of specimens with blunt cracks involves the initiation of a sharp crack in addition to the crack propagation. In static fatigue this crack initiation was found to require a far longer time than the crack propagation does. Furthermore, it was found that sharp crack initiation from a blunt tip under subcritical stress is possible only in water and not in non-aqueous liquids. Microhardness of glass in various liquids was investigated, and it was discovered that water enters SiO_2 glass during indentation while non-aqueous liquids do not.

11710 **(EFI—744(59)-84) Computer calculation of synchrotron topograms. 2. High-precision determination of crystal orientation on synchrotron diffractometer.** Abovyan, Eh.S.; Akopyan, G.S.; Bezirganyan, P.A.; Grigoryan, A.G.; Petrosyan, M.L. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); Erevanskij Gosudarstvennyj Univ. (USSR); Erevanskij Fizicheskij Inst. (USSR)). 1984. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700341.

A new method is suggested for the high-precision determination of the monocrystal orientation by X-ray pattern obtained on the synchrotron diffractometer. The problem is solved by measurement of reflex coordinates on the X-ray pattern-topogram of high resolution. Apart from the orientation refinement, the method also enables to refine precisely the distance between the crystal and the diffraction pattern registration plane, and to determine the location for the latter with respect to the incident radiation with a high accuracy. 6 refs.; 2 figs.; 2 tabs.

11711 (EFI—745(60)-84) Computer calculation of synchrotron topograms. 3. Determination of misorientation parameters of mosaic crystal. Abovyan, Eh.S.; Avetisyan, G.M.; Akopyan, G.S.; Bezirganyan, P.A.; Grigoryan, A.G.; Petrosyan, M.L. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); Erevanskij Gosudarstvennyj Univ. (USSR); Erevanskij Fizicheskij Inst. (USSR)). 1984. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700342.

The spectrum continuity and nealy parallel character of the synchrotron radiation enable to reveal the mosaic microstructure of imperfect crystals and to determine the misorientation angular parameters by a rather simple method that essentially differs from previous ones. The suggested new method is based on a high-precision determination of orientation of the crystal-sample separate blocks. The method enables to determine with a high accuracy (of the order one angular minute) the direction of the misorientation axis and the rotation magnitude of crystalline blocks (not necessarily having a common boundary on the diffraction pattern). 9 refs.; 3 figs.; 2 tabs.

11712 (EPRI-EM—4915) Resistance heating of nonmetals: State-of-the-art assessment: Final report. Hallowell, J.B. (Battelle Columbus Div., OH (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920169.

The glass, ceramics, refractories, abrasives, and plastics manufacturing industries were assessed for usage of electric-resistance heating. Noteworthy applications included the direct-resistance heating of molten glass, heating of glass for tempering and forming, and the increasing use of electric heating in the synthesis and processing of ceramics for electronic devices and new versions of silicon carbide, silicon nitride, boron nitride, etc. The plastics molding industry uses encased electric-resistance heaters for the heating of extrusion machines, molds, and dies. The use of electricity for glass melting is expected to increase at a rate of 2 to 3% per year as melting furnaces are retrofitted with electric-boost facilities or are converted to all-electric melting. Electric use for resistance heating in the other applications identified (advanced electronic and structural ceramics and plastics) is expected to increase in proportion to the forecast growth rates for those industries which are in the range of 4 to 5% per year.

11713 (EUR—9226) Improvement of functional thermal conductivity of polyurethane foams. Andreani, A.M.; Silvent, A.; Roux, G.; Balme, A.; Rivero, J.; Fogg, B. (Commission of the European Communities, Luxembourg). 1984. 60p. (In French). European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037.

Gas diffusion through the cell walls of rigid polyurethane foams, increases the K value of these products with time from about 18 mW/m K after processing to nearly 29 mW/m K. The research aims to achieve a significant improvement in the functional thermal conductivity of foams to 20 mW/m K by inhibition of gas diffusion after reduction of the initial K value and without incurring a serious increase in manufacturing costs. The programme was in two parts. The first stage, using only commercial raw materials, studied the decrease in the initial thermal conductivity, lambda zero measured 24 hours after processing, as well as the asymptotic value lambda infinite. The influence of the type and amount of catalyst, surfactant, foaming gas, the amount of air, the polyol type was taken in account. In the second stage particular attention was given to modification of polyols to increase their diffusion barrier effect on polyurethane. Reductions of diffusion kinetics keeps the lambda infinite value as a lower level. The minimal lambda infinite got is 19.6mW/m K. Tests were made in industrial plants to check the results.

11714 (FRNC-TH—2137) Contribution to the study of biopolymer/non ionic surfactant interaction in view of its application to enhanced oil recovery. Hernandez Aguirre, J. (Aix-Marseille-3 Univ., 13 - Marseille (France)). 1983. 83p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE87750980.

Interaction between a biopolymer (polysaccharide) and nonionic surfactant (ethoxyl nonylphenol) are determined by operational research. The study is carried out in a concentration domain (for both polymer and surfactant) allowing to maintain a minimal value to surface tension and a mobility close to crude oil. 42 refs.

11715 (INIS-SU—362, pp 37-40) Study of local states in $CdIn_2S_4$. Georgobiani, A.N.; Gruzintsev, A.N.; Tiginyanu, I.M. 1984. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780037.

Kratkie Soobshcheniya po Fizike. No. 9.

In Experimental and theoretical physics. Collection.

Spectra of impurity electroabsorption, photoconductivity and lambda-modulated luminescence of cadmium thioindate are studied. Energy state of deep centres level in forbidden connection zone is determined. 7 refs.; 3 figs.

11716 (IS-M—589) Systematic study of the high temperature transitions in first-stage alkali-graphites at saturation. Robinson, D.S.; McGlinn, T.C.; Zarestky, J.L.; Salamon, M.B. (Ames Lab., IA (USA); Illinois Univ., Urbana (USA). Materials Research Lab.). 1 Dec 1986. Contract W-7405-ENG-82. 4p. (CONF-861207—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001837.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Found in heavy A-GIC's in equilibrium with excess metal is a narrow two-phase coexistence region between ordered and disordered phases, with the disordered state a commensurate lattice liquid. An interesting question, whether the transition from commensurate to incommensurate liquid proceeds continuously with decreasing alkali pressure, remains to be explored. The qualitative differences observed between C_8Li and C_8M may be due to the alkali atoms of the latter exhibiting long range repulsion while the Li-Li interaction energy has a true minimum.

11717 (KFTI—85-16) Resonance interaction of helicon and spin oscillations in electron-impurity systems. Ivanchenko, E.A.; Krasil'nikov, V.V. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700343.

A system of electrons interacting with each other and with immovable chaoctic potential impurity centres in the presence of external constant magnetic field is considered. In the low temperature range the isotropization on the impulses of electron distribution function taken place due to electron scattering by impurities. The electric conductivity tensor is obtained for this distribution function on the basis of the iki e kinetic equation with regard for the electron spatial and time dispersion. The dispersion equation for the coupled waves (helicon waves interact with spin oscillations) is derived in the low-temperature approximation (T<epsilon sub(F)). In the region where the helicon frequency is close to the electron paramagnetic resonance frequency, a sharp dispersion takens place on the wave vector of the damping coefficients of oscillation branches, and the transformation of helicon waves to spin oscillations and inversely occurs. 8 refs.; 2 figs.

11718 (MLM—3400(OP)) Measurement of fatigue crack growth kinetics of Copper-Kapton laminates by dynamic mechanical thermal analysis. Pickard, J.M.; Walters, R.R. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1986. Contract AC04-76DP00053. 11p. (CONF-861004—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003024.

From 18. Society for the Advancement of Materials and Process Engineering national technical conference on materials; Seattle, WA, USA (7 Oct 1986).

Copper-Kapton laminates fabricated with epoxy and Du Pont WA acrylic adhesives are used in printed circuit applications that are of current interest to the Department of Energy. Kinetics for fatigue crack growth at the Cu-epoxy interface were measured under a helium atmosphere over the temperature range of 473 to 563 K by dynamic mechanical thermal analysis (DMTA). A least

squares treatment of data derived on the basis of a first-order fatigue mechanism resulted in: $\log[k(T)/s^{-1}] = (14.6 +- 0.4) - (175.4 +- 3.8)/2.303RT$, where k(T) is the rate coefficient for thermal fatigue, T is absolute temperature, and R is the ideal gas law constant (R = 0.00831 kJ/K mol). Error estimates for the pre-exponential factor and activation energy correspond to one standard deviation. Arguments are presented which indicate that the upper temperature limit for continuous use of the laminate is 85°C. It is concluded that the laminate will meet and possibly exceed the 27-y shelf life required by the DOE.

11719 **(MLM—3405) Effects of solvent exposures on poly(etheretherketone) (PEEK) and PEEK-fiberglass composites.** Whitaker, R.B.; Brown, C.R.; Carlson, R.S.; Trainer, P.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 15 Dec 1986. 22p. NTIS, PC AA02/MF A01; 4. File Number DE87004142.

Specimens of PEEK and PEEK-fiberglass (FG) were exposed to a number of solvents, and, after removal of the solvents, were tested for changes in weight, tensile strength, and thermal/chemical properties. Solvents tested included: Alconox/water, ethanol, trichloroethylene, ethylene glycol, toluene, Freon TF, silicone oil, and dilute (15%) NaOH and H_2SO_4 solutions. Expposures were for five days at temperatures up to 80°C. The only significant decreases in tensile strength after solvent exposure occurred with the dilute NaOH-exposed PEEK-FG specimens. Several samples showed minor weight changes. Differential scanning calorimetry showed that the ability of the solvent-exposed PEEK or PEEK-FG recrystallize was not affected, except in concentrated H_2S_4 (≧65 wt %) solutions. Similarly, infrared (ir) spectroscopic analyses showed no changes in solvent-exposed PEEK or PEEK-FG, except in ≧85% H_2SO_4, where minor changes in the ir spectrum were observed. Examination of the glass transition (Tg) region of concentrated (65%) H_2SO_4-exposed PEEK, the dilute NaOH-exposed PEEK-FG, and the dilute H_2SO_4-exposed PEEK-FG by thermomechanical and dynamic mechanical analyses showed no significant differences from unexposed controls. Similar results were obtained for alcohol- and trichloroethylene-exposed PEEK specimens. 7 figs., 9 tabs.

11720 **(N—86-31666) Temperature dependent nonlinear metal matrix laminae behavior. Final technical report, December 1984-November 1985.** Barrett, D.J.; Buesking, K.W. (Materials Sciences Corp., Spring House, PA (USA)). Sep 1986. 123p. (NASA-CR—4016; NAS—1.26:4016; MSC-TFR—1607/0211). NTIS, PC A06/MF A01.

An analytical method is described for computing the nonlinear thermal and mechanical response of laminated plates. The material model focuses upon the behavior of metal matrix materials by relating the nonlinear composite response to plasticity effects in the matrix. The foundation of the analysis is the unidirectional material model which is used to compute the instantaneous properties of the lamina based upon the properties of the fibers and matrix. The unidirectional model assumes that the fibers properties are constant with temperature and assumes that the matrix can be modelled as a temperature dependent, bilinear, kinematically hardening material. An incremental approach is used to compute average stresses in the fibers and matrix caused by arbitrary mechanical and thermal loads. The layer model is incorporated in an incremental laminated plate theory to compute the nonlinear response of laminated metal matrix composites of general orientation and stacking sequence. The report includes comparisons of the method with other analytical approaches and compares theoretical calculations with measured experimental material behavior. A section is included which describes the limitations of the material model.

11721 **(NUREG/CR—4714) Preliminary assessment of the performance of concrete as a structural material for alternative low-level radioactive waste disposal technologies.** MacKenzie, D.R.; Siskind, B.; Bowerman, B.S.; Piciulo, P.L. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Dec 1986. Contract AC02-76CH00016. 227p. (BNL-NUREG—52016). NTIS, PC A11/MF A01 - GPO. File Number TI87003905.

The objective of this study was to develop information needed to evaluate the long-term performance of concrete and reinforced concrete as a structural material for alternative LLW disposal methods. The capability to carry out such an evaluation is required for licensing a site which employs one of these alternative methods. The basis for achieving the study objective was the review and analysis of the literature on concrete and its properties, particularly its durability. In carrying out this program, criteria for evaluating performance of concrete and factors that can effect its performance were identified. The factors are both intrinsic, i.e., associated with composition of the concrete (and thus controllable), and extrinsic, i.e., due to external environmental forces such as climatic conditions and aggressive chemicals in the soil. A section of the report is devoted to the properties of coatings and their possible use in protecting concrete from chemical attack and enhancing its useful properties. The testing of concrete, using both accelerated tests and long-term non-accelerated tests, is discussed with special reference to its application to modeling of long-term performance prediction. On the basis of the study's results, minimum acceptance criteria are recommended as an aid in the licensing of disposal sites which make sure use of alternative methods.

11722 **(OEFZS—345) Determination of the wear of thermoplastic journal bearings in the initial strain.** Frevert, E.; Franek, F.; Piringer, R.; Suschnig, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jan 1986. 37p. (IA—146/86; ETN—86-97247). NTIS, PC A03/MF A01.

The measurement of the wear of thermoplastic journal bearings using the radionuclide technique was investigated. The activation of the bearings can lead to changes in the molecular structure if it lasts too long. The wear of six activated bearings of one type was obtained in a fixed sequence and for given peripheries of the shaft. The amount of wear was calculated by comparing the radiation intensity of the wear probes with that of a standard specimen. The detection limit is 2 microg. In spite of the deviations of the single values caused by unequal loads on axis, the mean values show an indication of a bedding-in process up to 4000 m operating length followed by relatively constant wear. The simultaneous activation analysis of the probes shows that the proportionate distribution of the trace elements in the wear and thus in the surface layer of the bearings is different from the average distribution in the whole bearings.

11723 (ORNL—6261, pp 69-95) **Materials chemistry.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

The activities of the first part of this program are focused on (1) the exploitation of nonequilibrium surface-modification techniques for the development of a better understanding of catalytic processes, and (2) the development of new methods for the synthesis of advanced (nonoxidic) ceramic materials. Rutherford backscattering, photoacoustic and photocurrent spectroscopies, and electrochemical techniques are used to determine the kinetics and mechanistics of the catalyzed reaction, the properties of the catalyst, and the specific mode of operation of the catalyst. Techniques applied to the characterization of intermediate and final products synthesized in the ceramic program include uv-Vis-FTIR and Raman spectroscopies, x-ray diffraction, and thermal analysis (DTA/TGA-mass spectroscopy). The second part of this program is concerned with the structure and dynamics of several materials. The purpose of this program is to understand and predict bulk mechanical, transport, thermodynamic, and other physical properties from a characterization at the molecular level. Sections discuss work on the structure of polymeric and amorphous materials. A sudy of diffusion in polystyrene is discussed along with some results on intramolecular motion. This treatment is based on classical and semiclassical mechanics. A technique for centering a sample in a diffractometer and for aligning the diffractometer is also discussed. 74 refs., 12 figs., 8 tabs.

11724 (ORNL—6261, pp 172-183) **Special topics.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

This section of the report is dedicated to special topics of interest. The topics discussed are: conservation programs; hypereu-

tectic heat storage alloy; solution thermodynamics for modeling ideal absorption heat pump fluids; microemulsion fuels; small-angle neutron scattering from amphiphile systems; and Raman spectroscopic studies of UO_2^{2+} association with hydrolytic species of group IV metals. (PLG)

11725 (ORNL—6302) Analysis of experimental determinations of the thermal conductivity of CBCF [carbon-bonded carbon fiber] insulation. Pawel, R.E.; Eatherly, W.P.; Robbins, J.M. (Oak Ridge National Lab., TN (USA)). Sep 1986. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87004025.

This report presents experimental data and addresses the extent of agreement between measurements of thermal conductivity of carbon-bonded carbon fiber (CBCF) insulation made by steady-state and transient heat flow methods. 17 figs., 8 tabs.

11726 (PUC-TN—25/84) Thermodynamic properties of pure and dilute alkali cyanides: short range order effects. Koiller, B.; Davidovich, M.A.; Lutty, F. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica; Utah Univ., Salt Lake City (USA). Dept. of Physics). 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700345.

The alkali-cyanides NaCN and KCN, both pure and mixed in alkali-halides are studied, in the low temperature phases (paraelectric and antiferroelectric). Experimental results on the dielectric properties of these systems indicate that short-range order effects are important. These effects are investigated using the Kikuchi method in the limit of the pair correlation approximation (Bethe approximation). The results for the temperature dependence of the dielectric constant, for the pure systems, are adjusted to the experimental data available to obtain the three relevant parameters of the model: coordination number, coupling interaction and electric dipole moment of the CN^- molecular ion. This parametrization is used in the study of the dielectric constants of the mixed systems and the critical temperature as a function of the CN^- dipole concentration is obtained. The results are in good qualitative agreement with the experimental ones.

11727 (PUC-TN—33/84) Non-equivalence effects in cluster self-consistent calculations of ionic solids. Matos, M.; Maffeo, B. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica; SERPRO - Servico Federal de Processamento de Dados, Rio de Janeiro (Brazil)). 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700346.

A simple model was used to analyse actual cluster calculations and an interpretation of the existence of central levels well separated from band levels is proposed for INDO Xα methods. The analysis shows that the convergence to the infinite solid through the use of a point charge boundary condition cannot in general eliminate this symmetry nonequivalence effect, which is related to the approximate treatment of two-electron interactions inherent to each kind of cluster method. For the INDO method a simple procedure is proposed to eliminate the effect.

11728 (PUC-TN—35/84) Photoluminescence measurements of the 1,55 eV band of Ge doped Al sub(x)Ga sub(1-x)As. Furtado, M.T.; Weid, J.P. von der. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1984. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700348.

The photoluminescence of the 1,55 eV band of Ge doped Al sub(x)Ga sub(1-x)As, with x=0.30-0.33, grown by liquid phase epitaxy is presented. The broad shape was found to be due to a lattice relaxation upon optical transitions. Resonant modes with $(h/2\pi)\omega$ sub(q) approx. 35 + - 2 meV and $(h/2\pi)\ \omega$ sub(q) approx. 45 + - 2 meV are found for the optical band, yielding a zero phonon transition energy - 1.73 + - 0.02 eV and a Franck-Condon shift approx. 0.17-0.20 eV for the optical center. The activation energy of thermal quenching yields an associated donnor binding energy of 0.17 + - 0.04 eV. Possible mechanisms for the radiative transitions are discussed.

11729 (PUC-TN—36/84) Specific heat measurements of the antiferroelectric phase transition in the mixed system KCN sub(x)Cl sub(1-x). Ghivelder, L.; Bastos, C.A.M.; Ribeiro, P.C.; Weid, J.P. von der. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700349.

The specific heat of KCN sub(x)Cl sub(1-x) mixed crystals was measured for four chlorine concentrations between x=0,90 and x=1,00. The entropy change ΔS and critical temperature T sub(c) were obtained and the results are discussed in terms of the orientational motion of the CN^- molecular ions.

11730 (SAND—86-1329) Development and implementation: Test Series B of the small-scale seal performance tests. Stormont, J.A.; Howard, C.L. (Sandia National Labs., Albuquerque, NM (USA); RE/SPEC, Inc., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003620.

The second in a series of in situ experiments to evaluate candidate salt repository sealing materials and sealing configurations has been initiated in the Waste Isolation Pilot Plant. Test Series B of the Small-Scale Seal Performance Tests is providing structural/thermal and fluid-flow information for the evaluation of horizontally emplaced expansive salt-water-based concrete seals. This report provides information necessary for evaluating these data, including "as built" test configurations and descriptions of activities such as drilling and seal and instrumentation emplacement, including the development of an adequate seal emplacement technique.

11731 (SAND—86-2487C) Epitaxial semiconductor optical interference filters. Gourley, P.L.; Biefeld, R.M.; Drummond, T.J.; Zipperian, T.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870220—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003153.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

This paper reviews experimental work in two materials systems: (1) filters fabricated with alternating layers of GaP and GaAsP grown by metal-organic chemical vapor deposition; and (2) filters of AlGaAs, AlAs, or GaAs grown by molecular beam epitaxy.

11732 (SAND—86-8248) Moisture absorption in graphite/organic-matrix composites. Odegard, B.C. Jr. (Sandia National Labs., Livermore, CA (USA)). Dec 1986. Contract AC04-76DR00789. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004229.

Moisture absorption of graphite-epoxy composites in humid air was investigated and the results compared with similar data taken on a graphite-thermoplastic resin composite. The composite materials were: P75/3501-6, IM6/5217c, and AS4/PEEK. In addition, the P75/3501-6 was tested in both the "as-cured" and "thermal cycled" condition. The measured diffusivity values for the P75/3501-6 were in good agreement with earlier investigators. The thermoplastic resin, PEEK, absorbed moisture at a very low rate compared to the thermosetting resins which was expected. The P75/3501-6 composite exhibited the same diffusivity value for both the "as-cured" and "thermally conditioned" conditions.

11733 Extension of the Lifshitz-point concept to first-order phase transitions: Incommensurate $NaNO_2$ in a transverse electric field. Qiu, S.L.; Dutta, M.; Cummins, H.Z.; Wicksted, J.P.; Shapiro, S.M. (Department of Physics, City College, City University of New York, New York 10031). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 7901-7910(1 Dec 1986).

The theory of the Lifshitz point, a triple point in the phase diagram of systems with incommensurate phases, is extended to systems in which the direct para-ferro transition is first order. The structure of the phase diagram is shown to be considerably more complex than in the usual case of a second-order direct transition. There is a virtual Lifshitz point at which the T/sub I/ and T_0 phase-transition lines cross, but it is not a triple point. A new tricri-

tical point is found at which the para-to-incommensurate transition changes from second to first order, and a new triple point is found, distinct from the virtual Lifshitz point. We present the results of an elastic neutron scattering study of the incommensurate ferroelectric $NaNO_2$ in transverse electric fields which exhibits behavior resembling that found in the theoretical analysis. We therefore extrapolate the experimental phase diagrams to construct a plausible picture of the region of the virtual Lifshitz point in $NaNO_2$.

11734 **Hugoniot overtake sound-velocity measurements on CsI.** Swenson, C.A.; Shaner, J.W.; Brown, J.M. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 7924-7935(1 Dec 1986).

Shock-wave overtake experiments have been used to confirm that CsI melts along the Hugoniot curve at a pressure of roughly 30 GPa. The experimental results give the pressure dependence of the bulk sound velocity in the fluid along the Hugoniot curve to 150 GPa, from which the pressure dependences of both the adiabatic bulk modulus and the Grueneisen parameter γ can be calculated. These quantities show normal behavior, with no obvious indication of the band closure and metalization which are predicted for this region of the Hugoniot curve. The results of these experiments are combined with the shock-wave optical pyrometry data of Radousky et al. [Phys. Rev. B 31, 1457 (1985)] to obtain results for the variation along the Hugoniot curve of both the constant-volume heat capacity (which increases by 30% from the melting line to 90 GPa) and the isothermal bulk modulus. The large values of C/sub V/, which are roughly twice the classical value for a solid, are the only indications of unusual behavior for CsI. Thermodynamic properties along the Hugoniot curve are consistent only with the diamond-anvil isotherm which used solid xenon as a pressure-transmitting medium.

11735 **Recent trends in III—V strained layer research.** Osbourn, G.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena;* **4**: No. 6, 1423-1426(Nov 1986). Contract AC04-76DP00789.

Current directions in III—V strained layer superlattice research are briefly reviewed. Areas of recent emphasis include the study of the tailorable light hole mass values, the development of new III—V strained layer materials for infrared detector applications, and work on modulation-doped field effect transistors employing strained quantum wells. Recent theoretical and experimental results as well as unresolved issues in these areas are discussed.

11736 **Recent Progress in Deuterium Triple-Point Measurements.** Schwalbe, L.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Physical and Chemical Reference Data;* **15**: No. 4, 1351-1356(Oct 1986).

The triple point of deuterium is a proposed reference for defining the temperature scale between 13.81 and 24.562 K. We review recent measurements of this fixed point; our discussion concentrates on experiments with samples confined in transportable sealed cells. We also present theoretical estimates of the dependence of the triple-point temperature on the spin composition of the sample. Satisfactory agreement is obtained with experimental data on deuterium at low concentrations of the para ($J = 1$) species. Present results support the adoption of the triple point of e-D_2 as a standard temperature reference.

11737 **Structural and thermodynamic properties of cointercalated titanium disulfide.** Johnson, W.B.; Worrell, W.L. (Dept. of Metallurgical Engineering, Ohio State Univ., Columbus, OH 43210). *Journal of the Electrochemical Society;* **133**: No. 9, 1966-1970(Sep 1986).

The structural and electrochemical characteristics of cointercalated titanium disulfide, Li/sub x/Na/sub y/TiS/sub 2/ have been investigated as a function of lithium content, x, for $y = 0.0$, 0.04, 0.16, 0.34, and 0.50. The open-circuit voltage of Li/sub x/Na/sub y/TiS/sub 2/ vs. lithium has been measured as a function of lithium concentration between 30° and 80°C. The variation of the EMF as a function of chi was the same in Li/sub x/Na/sub y/TiS/sub 2/ for $x + y < 1.0$ as that in Li/sub x/TiS/sub 2/ when $x <$ 1.0. The open-circuit voltage vs. lithium decreased to 1.0V when $x + y > 1.2$ and was nearly constant up to $x + y \approx 2.0$. Four structures have been observed in the Li/sub x/Na/sub y/TiS/sub 2/ materials as the lithium and sodium content is varied: a stage II structure, a stage I(TP) structure, a stage I(TAP) structure, and a IT structure. The structural and open-circuit voltage results have been used to construct a Li-Ti-S isothermal ternary cross section, a Li-Na-TiS/sub 2/ isothermal pseudoternary cross section and to assess the electrode applications of these novel materials. The Li-Na-TiS/sub 2/ isothermal pseudoternary cross section indicates that the smaller lithium ion is able to attain higher concentrations within a phase than that of the larger sodium ion. Thus, it appears that ionic size is an important parameter in determining the location of the phase boundaries in intercalated dichalcogenides.

11738 **Some in situ observations of GaAs oxidation.** Hall, M.; Rau, M.F.; Evans, J.W. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley, CA 94720). *Journal of the Electrochemical Society;* **133**: No. 9, 1934-1939(Sep 1986).

The oxidation of doped GaAs was studied using an environmental cell placed in a transmission electron microscope. By means of this device the oxidation was observed at temperatures from 320° to 600°C under a few tens of torr of oxygen. For temperatures up to 380°C amorphous reaction products were observed, while at temperatures of 450°C and above, polycrystalline β-Ga/sub 2/O/sub 3/ (formed via intermediate epitaxial γGa/sub 2/O/sub 3/ and polycrystalline γGa/sub 2/O/sub 3/) was found. A tentative explanation for this change from one product microstructure to another with temperature is advanced.

11739 **Magnetic susceptibility observation of removing oxygen from some chevrel compounds.** Wright, W.H.; Ginsberg, D.M. (Univ. of Illinois, Urbana, IL). *Journal of Low Temperature Physics;* **64**: No. 1/2, 73-86(Jul 1986).

A refined method for preventing the incorporation of oxygen into Chevrel compounds is presented. This method has been used in producing Cu /sub 1.8/ Mo_6S_8, $SnMo_6S_8$, and $PbMo_6S_8$. The removal of oxygen enhances the magnetic susceptibility of these materials as well as raising their superconducting transition temperatures. The curves of magnetic susceptibility versus temperature show structures that may indicate lattice deformations.

11740 **Noble gas-carbon dioxide thermal diffusion factors: anomalous behavior for Ar/$Co_2$1.** Taylor, W.L.; Pickett, P.T. (Monsanto Research Corp., Miamisburg, OH). *International Journal of Thermophysics;* **7**: No. 4, 837-850(Jul 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

Thermal diffusion factors for equimolar mixtures of neon and argon with carbon dioxide have been measured in the temperature range from 250 to 700 K. The data were obtained in a 20-tube trennschaukel, or "swing separator." The Ne/CO_2 system demonstrated the expected increase in α /SUB T/ with increasing temperature as predicted by the Chapman-Enskog theory using spherically symmetrical interaction potentials and elastic collisions. The thermal diffusion factor for Ar/CO_2, however, demonstrated an inverse temperature effect which is not explained by the simplified kinetic-theory model used for the calculation. While this effect has ben observed by other workers, the present data exhibit a less precipitous decrease with temperature. Using interaction potentials available in the literature, it was possible to calculate theoretically accurate values of α /SUB T/ for Ne/CO_2 but not for Ar/CO_2. In the latter case the small mass difference produced very small values of α / SUB T/ , the peculiar behavior of which undoubtedly lies in non-negligible asymmetric and inelastic effects not taken into account in the calculations.

11741 **An equation of state for isobutane-isopentane mixtures with corrections for impurities[1].** Gallagher, J.S. (National Bureau of Standards, Gaithersburg, MD). *International Journal of Thermophysics;* **7**: No. 4, 923-933(Jul 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

A global Helmholtz function accurately representing the thermodynamic properties of isobutane-isopentane mixtures over a wide range of temperatures and pressures has been developed. The Helmholtz function has been used for the generation by computer of tables and charts of properties of interest to designers of power cycles. This Helmholtz function has also been extended to allow for additional components in the mixture, thus enabling the accurate calculation of corrections to the thermodynamic properties when impurities are present in significant amounts.

11742 **Consideration of some dilute-solution phenomena based on an expression for the gibbs free energy[1].** Jonah, D.A. (National Bureau of Standards, Gaithersburg, MD). *International Journal of Thermophysics;* 7: No. 4, 935-948(Jul 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

Rigorous expressions based on the Lennard-Jones (6-12) potential, are presented for the Gibbs and Helmholtz free energy of a dilute mixture. These expressions give the free energy of the mixture in terms of the thermodynamic properties of the pure solvent, thereby providing a convenient means of correlating dilute mixture behavior with that of the pure solvent. Expressions for the following dilute binary solution properties are derived: Henry's constant, limiting activity coefficients with their derivatives, solid solubilities in supercritical gases, and mixed second virial coefficients. The Henry's constant expression suggests a linear temperature dependence; application to solubility data for various gases in methane and water shows a good agreement between theory and experiment. In the thermodynamic modeling of supercritical fluid extraction, we have demonstrated how to predict new solubility-pressure isotherms from a given isotherm, with encouraging results. The mixed second virial coefficient expression has also been applied to experimental data; the agreement with theory is good.

11743 **Electron density of states in random systems.** Soukoulis, C.M. (Ames Lab., Iowa State Univ, Ames, IA). pp 21-26 of Hydrogen in disordered and amorphous solids. Bambakidis, G.; Bowman, R.C. New York, NY; Plenum Press (1986). (CONF-8509318—).

From Fundamentals of natural gas regulation: short course for energy users; Washington, DC, USA (18 Nov 1986).

The well-known result of Halperin and Lax for the tail of the density of an electron moving in a Gaussian random potential is reviewed. We then show that complete universality exists for the density of states near band edges for weak disorder in less than two dimensions and modified universality exists in more than two dimensions. Deep in the tail, non-universal behavior emerges as the localized states become sensitive to potential fluctuations on individual sites. This non-universal exponential behavior is responsible for the observed Urbach tails.

11744 **Point defects and the mechanisms of electrical conduction in olivine.** Schock, R.N.; Duba, A.G. (Lawrence Livermore National Lab., CA). pp 88-96 of Point defects in minerals. Washington, DC; American Geophysical Union (1985). Contract W-7405-ENG-48.

Measurements of electrical conductivity on single crystals of naturally occurring olivine and synthetic forsterite as a function of oxygen fugacity indicate that point defects play a crucial role in this process. Conductivity data (at 1200°C) reveal n-type conduction in forsterite and p-type conduction in natural peridot. Since the activation energies for conduction (2-3 eV) are well below the measured band gap in these olivines, conduction must be either an extrinsic electronic or an ionic process. Expected energy levels of impurities such as iron are such that either ionic or electronic charge carriers are energetically favorable. The electrical conductivity of forsterite decreases with increasing oxygen fugacity, which is consistent with conduction by electrons. Electrons are made available for conduction by the loss of oxygen from the crystal, which produces point defects and free electrons. Favorable defects include oxygen vacancies and magnesium and silicon interstitials. However, in the presence of iron, as in olivine, conductivity increases with increasing oxygen fugacity. Ferrous iron in the olivine can be oxidized to the ferric state as oxygen fugacity increases. In this case it is not necessary to produce electrons to balance the charge, since the creation of magnesium vacancies accomplishes the same result. Trivalent iron now carries the charge as if it were an electron hole. It is likely that that magnesium vacancies created to balance the charge also affect other physical properties, including creep, diffusivity, and possibly acoustic attenuation. 48 references, 4 figures.

11745 **Non-linear dynamics, breathers and photoinduced absorption in polyacetylene.** Bishop, A.R.; Campbell, D.K.; Lomdahl, P.S.; Horovitz, B.; Phillpot, S.R. (Los Alamos National Lab., NM). *Synthetic Metals;* 9: 223-239(1984).

The authors study the dynamics of trans-(CH)/sub x/ within the adiabatic approximately to the model of Su, Schrieffer and Heeger (SSH). The authors show, both by a qualitative analytic estimate and by quantitative numerical results, that a single soliton has a maximum velocity, v/sub m/, which can be higher than the velocity of sound. Further, using a long-time numerical simulation, the authors demonstrate that, from an initial electron-hole pair, such as would be generated in photoinduced experiments, a soliton and antisoliton emerge with velocities +/- v/sub m/ and that a persistent, spatially localized, time-periodic non-linear oscillation - a breather - is left behind. The authors argue that this breather may account for the high energy, intra-gap structure observed in photoinduced absorption in both trans- and cis-(CH)/sub x/, including isotope dependence recently observed in experiments on trans-(CH)/sub x/ and trans(CD)/sub x/. 26 references, 9 figures.

11746 **Structure data form light scattering studies of aerogel.** Hunt, A.J.; Berdahl, P. (Lawrence Berkeley Lab., CA). *Materials Research Society Symposia Proceedings;* 32: 275-280(1984).

This paper reports a recent advance in the understanding of the structure of microporous optical materials such as aerogel through the interpretation of light scattering data. The Fourier transform of the density-density correlation function is used to relate measurements of the angular dependence of scattered light to material structure parameters. The results of the approach fit the unusual dependence of the intensity of scattered light as a function of angle for two polarizations. The fit shows that light scattering from aerogels may be interpreted as having two origins; one from the small scale structure of linked particles that comprise the material, and the second due to weak fluctuations in the average density of the microporous structure over distances significantly larger than the pore size.

11747 **X-ray photoelectron and infrared spectroscopic studies of the decarboxylation/oxidation of cerium(III) carbonate octahydrate.** Perry, D.L.; Tsao, L.; Brittain, H.G. (Lawrence Berkeley Lab., CA). *Journal of Materials Science Letters;* 3: 1017-1019(1984). Contract AC03-76SF00098.

In view of the importance of the Ce(III)/Ce(IV) couplet as an analogue for trivalent and tetravalent actinides, the role of carbonate and oxide species in the mechanism of the chemistry of transport of these species in geologic media, and the extensive use of cerium oxides in catalysis, this laboratory has studied the X-ray photoelectron and infrared spectroscopic properties of both $Ce_2(CO_3)_3 \times 8H_2O$ and its decomposition products. These results in turn have been compared to similar data already in the research literature in an effort to learn if previously reported evidence indicating mixed cerium (III,IV) thermolysis products can be substantiated for even higher temperatures.

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11748 **(ORNL—6261) Chemistry Division annual progress report for period ending January 31, 1986.** (Oak Ridge National Lab., TN (USA)). May 1986. Contract AC05-84OR21400. 208p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86011391.

This report has been indexed by 11 separate chapters. The subjects covered are: coal chemistry, aqueous chemistry at high temperatures and pressures, geochemistry, materials chemistry, chemistry of transuranium elements and compounds, separations

chemistry, catalysis, electron spectroscopy, nuclear waste chemistry, heuristic modeling, and special topics. (PLG)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 10707, 10734, 10752, 10752, 10878, 10909, 10980, 10984, 11692, 12558, 12558

11749 (CONF-860753—7) Improved determination of backscattering amplitude and phase shift functions. McKale, A.G.; Chan, S.K.; Veal, B.W.; Paulikas, A.P.; Knapp, G.S. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy; Surface Science Labs., Mountain View, CA (USA)). Jul 1986. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001535.

From International conference on EXAFS and near edge structure; Saumur, France (7 Jul 1986).

Procedures for analysis of EXAFS data require knowledge of the phase shift and amplitude functions, PHI(k) and B(k). We present procedures to obtain these functions, both experimentally and theoretically, that overcome limitations in presently available methods. A procedure is described that allows for the use of crystallographically complex materials to serve as standards in the experimental determination of PHI(k) and B(k). Also we present a convenient algorithm, that uses the full curved wave formalism, to determine the functions theoretically. Improved results are obtained, particularly at low k. We illustrate the use of these procedures with a study of the 3d transition metals.

11750 (DOE/ER/13329—2) A design and synthesis procedure for homogeneous and heterogeneous azeotropic distillations: Annual report for period March 1, 1986 to February 29, 1987. Doherty, M.F. (Massachusetts Univ., Amherst (USA). Dept. of Chemical Engineering). 15 Dec 1986. Contract FG02-85ER13329. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003383.

The column sequencing problem for heterogeneous azeotropic distillation is investigated. It is shown that residue curve maps play an important role in interpreting the behavior of these systems. Classes of residue curve maps which give rise to feasible column sequences are identified. Several kinds of sequences are presented and it is shown that the conventional sequence frequently requires much larger reflux ratios than other alternatives.

11751 (DOE/ER/13357—2) Interfacial chemistry in solvent extraction systems: Progress report for period April 1, 1986-March 31, 1987. Neuman, R.D. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). Nov 1986. Contract FG05-85ER13357. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003911.

Proton magnetic resonance spectroscopic, vapor pressure osmometric and Karl Fischer titrimetric measurements have provided support for our earlier findings obtained from interfacial tension and mass transfer experiments that reversed micelles are formed, under certain conditions, in the system HDEHP/n-hexane/$CaCl_2$ solution. These studies were further extended to include different organophosphorus acid (PC 88A), diluent (benzene), and metal ions (Co^{2+}, Ni^{2+}, and Zn^{2+}) to determine whether reversed micellization is a general phenomenon occurring in solvent extraction systems which employ organophosphorus acids. The data obtained so far, suggest that reversed micellization indeed is a general phenomenon operative in organophosphorus acid extractant systems. A new mass transfer cell has been constructed in order to investigate the metal distribution equilibria and extraction kinetics of Co, Ni and Zn using atomic absorption spectrophotometric technique. A quasi-elastic light-scattering apparatus has been installed to investigate aggregation phenomena in solvent extraction systems. Preliminary drop-interface coalescence studies were performed, and the results were correlated with those obtained from interfacial tension measurements. The laser heterodyne light-scattering apparatus for measurement of interfacial viscoelastic properties also has been set-up and is being optimized for high resolution measurements. 21 refs., 16 figs.

11752 (DOE/ER/45208—2) [He-atom surface scattering apparatus for studies of crystalline surface dynamics]: Progress report covering the period from May 1, 1986 to April 30, 1987. Skofronick, J.G. (Florida State Univ., Tallahassee (USA)). [1986]. Contract FG05-85ER45208. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003916.

The primary goal of this grant is the construction of a state-of-the-art He atom-crystal surface scattering (HASS) apparatus which will be capable of measuring both elastic and inelastic scattering of He atoms from crystal surfaces of metals, semiconductors and insulators. The time period for the construction was projected to be approximately three years, after which a program of studies on the surface dynamics of various crystal surfaces would be started. The project was begun on May 1, 1985 and is now nearing the end of the second year of construction.

11753 (DOE/PC/90515—1) Entrainer effects in high pressure separation processes: Quarterly technical progress report for period September 15, 1986 to December 14, 1986. Donohue, M.D. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemical Engineering). Jan 1987. Contract FG22-86PC90515. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004102.

The compounds of interest in high pressure separation processes include coal compounds, pharmaceuticals, food extracts, and various specialty chemicals. These solute compounds are large, multifunctional, and have several Lennard-Jones, polar, and hydrogen bonding groups. In high pressure separation processes the primary solvent is a small compound such as ethane, propane, or carbon dioxide. Entrainer solvents such as methanol or acetone are added to increase the selectivity and yield. The most effective entrainer solvents are those that form specific interactions with the solute. Very little solubility data are available and there have been no studies that include spectroscopic analysis with solubility measurement. The objective of this research is to theoretically model specific interactions in high pressure gas mixtures and to obtain the solubility and spectroscopic data necessary to develop the model. Progress during this quarter has been in two areas. First, we are designing a spectroscopic view cell which will contain a high pressure gas mixture and allow measurements of infrared absorption. Second, we are developing the Associated Perturbed Anisotropic Chain theory (APACT) to model mixtures of molecules that have multiple polar, Lennard-Jones, and hydrogen bonding interactions. The first mixtures that we plan to study both theroretically and experimentally will use fluorenone as the solute, ethane or carbon dioxide as the primary solvent and methanol or chloroform as the entrainer solvent. 1 tab.

11754 (DOE/SR/00001—T120) Gas phase reactions of ruthenium tetroxide with nitrogen oxides: Final report. Brittain, R.D.; Hildenbrand, D.L. (SRI International, Menlo Park, CA (USA)). 5 Apr 1985. Contract AC09-76SR00001. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002660.

High temperature mass spectrometry has been used to study gaseous reactions between ruthenium tetroxide and various oxides of nitrogen, alone, and in the presence of nitric acid of water vapor. Gaseous reactants were monitored and a search was made for possible reaction products in the temperature range 25-130°C. Reactant gas pressures varied in the range from 10^{-9} to 10^{-6} atm. Although the steady-state level of RuO_4 in the reactor is reduced significantly in the presence of H_2O, NO, and NO_2, it was not possible to elucidate the chemistry of these processes. Molecular RuO_4 itself is thermodynamically unstable under these conditions, and it may be that the destruction mechanism involves catalysis of the decomposition reaction to RuO_2(s). The dependence of RuO_4(g) pressure on the pressure of added NO and NO_2 is presented in tabular and graphical forms. 10 refs., 5 figs., 3 tabs.

11755 **(INIS-BR—561) Geochemical behavior of trace elements in sediments from the Mariana Pimentel-Faxinal area, Guaiba municipality, state of Rio Grande do Sul, Brazil** . Correa da Silva, Z.C.; Piccoli, A.E.M. (Sociedade Brasileira de Geologia, Sao Paulo; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Geociencias). 1985. 11p. (In Portuguese). (CONF-8510375—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700435.

From 2. geology South Brazilian symposium; Florianopolis, Brazil (1 Oct 1985).

The trace elements Zr, Y, Sr, U, Rb, Th, Ga, Pb, Zn, Cu, Ni, Co, Cr, Ce, Ba and La were determined by X-Ray fluorescence spectroscopy on samples from shales, carbonaceous shales, coal and fine-grained groundmass of a paraconglomerate (pedra-areia) collected from the Papaleo and Faxinal outcrops and from the Faxinal Coal Mine, Guaiba, RS. The analysis pointed out an association of zirconium, copper, uranium and thorium with coal and carbonaceous rocks, whereas barium and gallium are related to inorganic rocks. The other elements showed neither preferential relationships with organic nor inorganic matter. The extremely high contents of uranium, cerium and lanthanum in the upper coal layers in both Papaleo and Faxinal outcrops suggest an association with the top of the Rio Bonito Formation in this area.

11756 **(INIS-mf—10519) Conference on instrumental activation analysis IAA 86. Abstracts of papers.** Vobecky, M.; Obrusnik, I. (eds.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). Apr 1986. 51p. (In Czech and Slovak). (CONF-8605203—Absts.). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408.

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

Thirty five papers were presented at the conference held in Klucenice, Czechoslovakia from May 4 to 8, 1986. The abstracts of all papers are printed in the proceedings. The conference discussed the following problem areas: the application of activation analysis in determining elements in ores, tectites, fungi, the thyroid, the primary circuit coolant, semiconductor materials; the application of nuclear reaction analysis in determining elements in rubber and coal; the application of tracer techniques in metallurgy; the description of alpha and gamma spectrometric systems and their testing; the use of microcomputers for data processing, and the description of programs. (J.P.).

11757 (INIS-mf—10519, pp 10-12) **Iron and sulfur determination in coal using reaction (n,γ) and BGO scintillator.** Konicek, J.; Janout, Z.; Pospisil, S.; Vobecky, M.; Drahonovsky, R. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska; Ceskoslovenska Akademie Ved, Prague. Ustav Nuklearni Biologie a Radiochemie; Geoindustria, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11758 (INIS-mf—10519, pp 13) **Samarium and gadolinium determination in ore samples using prompt gamma radiation produced in thermal neutron capture.** Bartos, M.; Becvar, F.; Dousova, E.; Jansky, I.; Trhlik, M.; Kralik, M. (Karlova Univ., Prague, Czechoslovakia. Fakulta Matematicko-Fyzikalni; Ceskoslovenska Akademie Ved, Prague. Ustav Dozimetrie Zareni). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11759 (INIS-mf—10519, pp 14) **Lithium traces determination in thermoplastic rubber.** Cervena, J.; Hnatowicz, V.; Kvitek, J.; Vacik, J.; Virt, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky; Vyzkumny Ustav Syntetickeho Kaucuku, Kralupy nad Vltavou, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11760 (INIS-mf—10519, pp 15) **Neutron and gamma activation analysis of moldavites and microtectites.** Randa, Z.; Bouska, V. (Ustav Nerostnych Surovin, Kutna Hora, Czechoslovakia; Karlova Univ., Prague, Czechoslovakia. Prirodovedecka Fakulta). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11761 (INIS-mf—10519, pp 16) **Preparation and INAA analysis of reference plant material.** Jiranek, V.; Tluchor, D.; Sucmanova, M.; Mirch, R. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia; Vysoka Skola Veterinarni, Brno, Czechoslovakia; Vyzkumny Ustav Potravinarskeho Prumyslu, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11762 (INIS-mf—10519, pp 17-18) **Preparation of thyroid tissues for trace element determination by NAA.** Havelka, J.; Kvicala, J. (Vyzkumny Ustav Endokrinologicky, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11763 (INIS-mf—10519, pp 19) **Basic study of selected trace elements in thyroid using NAA.** Kvicala, J.; Havelka, J.; Roehling, S. (Vyzkumny Ustav Endokrinologicky, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11764 (INIS-mf—10519, pp 20-21) **Trace element determination in materials with high boron content using neutron activation analysis.** Kucera, J.; Soukal, L. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11765 (INIS-mf—10519, pp 22) **NAA determination of small amounts of gold in platinum.** Tluchor, D.; Jiranek, V.; Janu, M.; Hospes, M. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11766 (INIS-mf—10519, pp 23) **Determination of horizontal and vertical distribution of some dopants in silicon plates using INAA.** Janu, M.; Stverak, B.; Kopejtko, J. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11767 (INIS-mf—10519, pp 24) **Biogeochemical interpretation of detailed INAA study of trace element level in higher fungi.** Randa, Z. (Ustav Nerostnych Surovin, Kutna Hora, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11768 (INIS-mf—10519, pp 25) **X-ray fluorescence investigation of an Indian miniature from the beginning of the 17th century.** Frana, J.; Mastalka, A. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11769 (INIS-mf—10519, pp 26) **Use of radioanalytical methods in field and laboratory research of deep sea sediment composition.** Lenk, J.; Randa, Z. (Ustav Nerostnych Surovin, Kutna Hora, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11770 (INIS-mf—10519, pp 46) **Computer evaluation of radiochromatograms.** Hospes, M.; Svoboda, V.; Vavra, S. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11771 (INIS-mf—10519, pp 47) **Evaluating the degree of deviation of multiparameter results in radioanalytical methods.** Podracky, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Geologie a Geotechniky). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11772 (INIS-mf—10519, pp 51) **Microcomputers in radionuclide X-ray fluorescence analysis.** Cechak, T.; Kluson, J. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Jaderna a Fysikalne Inzenyrska). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11773 (INIS-mf—10519, pp 32-33) **Concentration and separation of selected radionuclides from water samples by coprecipitation.** Obdrzalek, M.; Liskova, J.; Janecka, S.; Slavik, O. (Ustav Krajinne Ekologie CSAV, Ceske Budejovice, Czechoslovakia; Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11774 (INIS-mf—10519, pp 29) **Application of gamma spectrometry in studying tantalum carbide chlorination.** Vanicek, M.; Mayer, J. (Vyzkumny Ustav Hutnictvi Zeleza, Dobra, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11775 (INIS-mf—10519, pp 27-28) **Application of radioisotope tracers in the study of continuous steel casting.** Mayer, J.; Hons, J.; Mrazek, L. (Vyzkumny Ustav Hutnictvi Zeleza, Dobra, Czechoslovakia). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11776 (IS-T—1277) **Instrumental and computational techniques for obtaining analytical data in high performance liquid chromatography.** Synovec, R.E. (Ames Lab., IA (USA)). Nov 1986. Contract W-7405-ENG-82. 246p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003053.

High performance liquid chromatography (HPLC) has developed into a useful tool for chemical analysis. In the specific context of using HPLC, developments in three distinct areas are presented and discussed in detail. It has been accepted that qualitative analysis must precede quantitative analysis in applying any analytical procedure. Investigations have shown that quantitative analysis may be performed concurrent with qualitative analysis, thus, solving this problem. These results are presented for HPLC systems using a refractive index detector. In HPLC, the limit of detection, as conventionally defined, becomes worse with increased retention due to band broadening. An integration method is presented and studied that overcomes this limitation, to a large extent, providing better analyte detectabilities. The advent of microbore HPLC technology has brought about the need for developing small volume detectors without sacrificing detectability or selectivity. Both transmission detected circular dichroism and fluorescence detected circular dichroism were studied and developed into laser-based HPLC detection systems. 147 refs.

11777 (KFTI—84-24) **Activation analysis on the 9.1 MeV proton beam.** Kuz'menko, V.A.; Remaev, V.V.; Goncharov, K.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1984. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700409.

Activation method is used to measure γ-ray absolute yields from thick targets for 54 elements. On the basis of these data potentialities of activation analysis of impurities with the help of nuclear reactions caused by 9.1 MeV protons are discussed. Values of absolute yields are presented. Nuclear reactions with above energy protons may be recommended to determine impurities of 26 of investigated elements. Experimental gamma spectra are presented for them. Results of investigations may be used in activation analysis of pure materials at solving problems of radioactive isotope accumulation and while evaluating radiation situation at proton accelerators. 11 refs.; 24 figs.; 3 tabs.

11778 (LA—10793-MS) **The development of a state-of-the-art assay system for uranium-235 in solutions.** Parker, J.L.; Sampson, T.E.; Cowder, L.R.; Kern, E.A.; Garcia, D.L.; Ensslin, N. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003496.

We describe the development of a high-accuracy, high-precision, and high-throughput system for the assay of ^{235}U in solution samples. The tradeoffs involved in the various development steps are discussed and the ultimate system performance is documented. Assay accuracy and precision better than 0.2% should be attained in routine use. This is a significant improvement in the state of the art.

11779 (LA—10813-MS) **Quality assurance for health and environmental chemistry, 1985.** Gautier, M.A.; Gladney, E.S.; O'Malley, B.T. (Los Alamos National Lab., NM (USA)). Oct 1986. Contract W-7405-ENG-36. 238p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003809.

This report documents the continuing quality assurance efforts of the Health and Environmental Chemistry Group at the Los Alamos National Laboratory. The philosophy, methodology, and computing resources used by the quality assurance program to encompass the diversity of analytical chemistry practiced in the group are described. Included in the report are all quality assurance refer-

ence materials used, along with their certified or consensus concentrations, and all analytical chemistry quality assurance measurements made by HSE-9 during 1985. 26 refs., 5 figs., 25 tabs.

11780 **(MINTEK-M—269) The determination by x-ray fluorescence of platinum, palladium, ruthenium, iron, and chromium in special steels.** Eddy, B.T. (Council for Mineral Technology, Randburg (South Africa). Analytical Science Div.). 29 Aug 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900429.

This report describes the analysis of special corrosion-resistant steels for ruthenium, palladium, and platinum by x-ray-fluorescence spectrometry (XRFS) and a thin-film technique. Precision varies from 1 to 7%. Accuracy is good. The direct determination of these elements on solid samples with the use of scattered radiation as a matrix correction is only partly successful and is not recommended. The three platinum-group elements, iron, and chromium can be determined successfully in solid samples by XRFS if an empirical interelement, iron, and chromium can be determined successfully in solid samples by XRFS if an empirical interelement correction method is used. The correction factors are determined by a multiple-regression method. The precision of the determination of the platinum-group elements is about 1% and that of iron and chromium about 0,2%. The accuracy is in most cases better than 2% for all the elements determined. The method can be implemented with the use of available computer software and a small microcomputer. The two recommended laboratory methods are given as appendices to the report.

11781 **(NUCLEBRAS-CDTN—490) Researches on uranium enrichment carried out in Centro de Desenvolvimento da Tecnologia Nuclear.** Campos, J.L.; Coelho, J.S.; Lemos, J.W.; Yadoya, R.; Consiglio, R.V. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 14p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700410.

The first researches on uranium enrichment by the Jet Nozzle Process, were carried out initially by the Nuclear Research Center of Karlsruhe - KfK, in Germany. The process development received a decisive thrust in 1975, when NUCLEBRAS and other German institutions decided to join the efforts in order to demonstrate the technical and economical feasibility of the process. More recently, some experimental facilities have been transferred from KfK to the NUCLEBRAS' Research Center - CDTN, where are providing relevant data concerning to the behaviour of advanced Separation Elements and enrichment Cascades. The experience acquired by CDTN is being used to support the implantation activities of the uranium enrichment plant being erected in Resende.

11782 **(NUCLEBRAS-CDTN—527) Use of electrothermal atomization for determining metallic impurities in nuclearly pure uranium compounds.** Franco, M.B. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 129p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. File Number DE87700411.

Atomic absorption spectrometry with electrothermal atomization was used for the determination of Al, Cd, Cr, Fe, Mn, Mo and Ni as impurities in uranium oxide samples. The determinations were performed in solubilized samples both with and without uranium separation as well as in solid samples.

11783 **(NUCLEBRAS-CDTN—531) Determination of metallic impurities in nuclearly pure uranium compounds by electrothermal spectrophotometry.** Franco, M.B. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 16p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700412.

Atomic absorption spectrometry, with electrothermal atomization, has been used for the determination of Al, Cd, Cr, Fe, Mn and Ni in uranium oxide standards. The analysis were performed without sample dissolution and without uranium chemical separation. This technique is adequate for the qualification of nuclearly pure uranium, according to the standard specifications.

11784 **(NUCLEBRAS-CDTN—538) Simultaneous determination of uranium and thorium by delayed neutrons, using different relations between fast and thermal neutron flux.** Cardoso, S.N.M.; Sabino, C.V.S.; Kastner, G.F. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 13p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700414.

The uranium and thorium simultaneous determination method by delayed neutrons, established in TRIGA IPR-R1 reactor, is based in the elements discrimination by difference between fast and thermal neutron flux relations. This method was tested in determination of U_3O_8 and ThO_2 contents in IAEA samples, which were irradiated in different neutron flux positions and cadmium was used as thermal neutron filter.

11785 (ORNL—6261, pp 121-137) **Separations chemistry.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

This research employs a multifaceted approach to understanding the fundamental role of molecular structure and bonding in determining the chemical selectivity and physical properties of solvent-extraction and related separation systems. Systematic studies of synergistic combinations of crown ethers and organophilic acids as extractants for alkali, alkaline earth, and transition metal cations are followed by detailed analyses of the more promising systems. Systematic studies are also being made of polymer-supported organophosphorus extractants. The detailed analyses are designed to ascertain as much as possible about the thermodynamics of the reactions and the structures of the participants in them. The techniques used include computer-assisted analysis of extraction equilibrium measurements and of osmometry to identify the species formed in the organic phase. FT infrared, Raman, and NMR spectral measurements are made to determine the nature of their bonding and to correlate their structure with that of solids determined by X-ray diffraction of single crystals. Finally, efforts are underway to synthesize extractant molecules which will exploit those principles of extraction which are evolving in this work.

11786 (ORNL—6261, pp 155-161) **Electron spectroscopy.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

The basis of the photoelectron dynamics of atoms and molecules is being constructed with the aid of angle-resolved photoelectron spectroscopy coupled to synchrotron radiation. Molecular studies have concentrated on (1) autoionization between the spin-orbit split states of HI and (2) the Cooper minimum in the chloromethanes and in the mixed halide, ICl. Work on atomic vapor has included the investigation of the lightly bound electrons in lead, the 4f electrons in ytterbium and the 4d electrons in tin. 17 refs., 5 figs., 1 tab.

11787 **(ORNL/TM—10218) Characterization of low-level liquid wastes at the Oak Ridge National Laboratory.** Peretz, F.J.; Clark, B.R.; Scott, C.B.; Berry, J.B. (Oak Ridge National Lab., TN (USA)). Dec 1986. 94p. NTIS, PC A05/MF A01. File Number DE87004038.

This report compiles and evaluates existing data on samples taken from the Oak Ridge National Laboratory Low-Level Liquid Waste (LLW) system. Although the primary focus is on the contents of the eight 50,000-gal Melton Valley Storage Tanks, data on raw LLW from the source facilities, Evaporator Service Tanks, and past operations involving the Gunite Storage Tanks are also included. A brief overview of the ORNL LLW system is provided. Methods of sample collection and analytical procedures are described. Data from each set of samples are reported and evaluated against criteria for classification of wastes. The quality and self-consistency of the data set are also discussed. Issues ranging from classifying as transuranic or Resource Conservation and Recovery Act hazardous waste to providing input for dose-rate calculations and evaluations of chemical compatibility with potential processing op-

tions are discussed. Remaining data voids are identified, and activities for filling those voids are recommended. 13 figs., 41 tabs.

11788 **(PNL—5733) Separation of gas mixtures by supported complexes.** Nelson, D.A.; Lilga, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003963.

A system was investigated that catalyzes the dehydrogenation of alcohols and the hydrogenation of ketones. Such a catalyst, if used in a membrane containing an alcohol solvent, might be of use in selective H_2 separation from gas mixtures. The dehydrogenation of cyclohexanol and 2-octanol were studied using a $RhCl_3$/$SnCl_2$/LiCl catalyst system. These alcohols are dehydrogenated at rates that are initially rapid, but which gradually slow to a stop. The decrease in rate of H_2 evolution is a result of the establishment of an equilibrium between the alcohol and the liberated hydrogen and ketone. At 150°C, cyclohexanol has the fastest rate of dehydrogenation. Several dehydrogenation/hydrogenation cycles have been carried out using this alcohol over a period of one week without serious catalyst deactivation or side reactions. Initial tests of the catalyst dissolved in cyclohexanol within two membranes were inconclusive. An anion exchange membrane was not suitably wetted by the catalyst solution and Celgard/sup TM/, which was wetted, could not be kept wet at 150°C under flow conditions in the membrane cell. 9 refs., 3 figs., 1 tab.

11789 (ZfI-Mitt—109, pp 5-26) **Investigations on microbial leaching of zircon by means of spark source mass spectrometry.** Becker, S.; Dietze, H.J.; Bullmann, M.; Iske, U. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung; Akademie der Wissenschaften der DDR, Leipzig. Inst. fuer Biotechnologie). Dec 1985. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780054.

In Report of the Central Institute for Isotope and Radiation Research.

Spark source mass spectrometry is a useful method for chemical element analysis of geological and biological samples. This sensitive technique (detection limit down to the ppb-range) is used to analyze leaching processes by means of several microorganisms. The problem of microbial leaching of chemical resistent materials was tested under laboratory condition with regard to possible analytical and technical applications. Leaching of metals with chemolithotrophic and heterotrophic, organic acids producing microorganisms has been investigated with zircon from Baltic Shield containing 0.7% rare earth elements and 1.67% hafnium. When zircon is leached with strains of Thiobacillus ferroxidans the rare earth elements, Hf, Th, and U mostly (about 80%) can be recovered.

11790 **Performance of annular membrane and screen-tee reactors for postcolumn-reaction detection of metal ions separated by liquid chromatography.** Cassidy, R.M.; Elchuk, S.; Dasgupta, P.K. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Analytical Chemistry;* 59: No. 1, 85-90(1 Jan 1987). Contract FG05-84ER13281.

The experimental factors that contribute to base line noise in the postcolumn-reaction detection of metal ions eluted from high-performance dynamic ion exchangers have been evaluated and compared for a screen-tee reactor (~ 1 μL internal volume) and three annular membrane reactions having internal volumes of 1.5, 5.3, and 9.6 μL. Measurements of mixing homogeneity, performed with pulseless gas-pressure pumping, showed that both reactor designs gave a mixing homogeneity that was 99.983% of that theoretically possible (perfect mixing) for two solutions differing in absorbance by 2.38 units. For normal operation with high-performance reciprocating pumps for eluent delivery, pump pulsations were responsible for 90-100% of the observed peak-to-peak noise. Column efficiency measurements with a series of lanthanide metal ions gave similar curves for both designs (HETP values of 0.01-0.04 mm). Both reactors gave reproducible peak areas, had good peak shapes, and operated reliably. With the membrane reactors some leakage of eluent into the reagent solution occurred at high eluent or reagent flow rates, but this was not a problem for normal operating conditions.

11791 **Simultaneous determination of americium and plutonium by liquid scintillation counting using a two-phase cocktail.** Miglio, J.J. (Los Alamos National Lab., NM). *Analytical Chemistry;* 58: No. 14, 3215-3218(Dec 1986). Contract W-7405-ENG-36.

A method for the simultaneous determination of ^{238}Pu and ^{241}Am by liquid scintillation counting using a multichannel instrument has been developed. A two-phase cocktail is employed that separates ^{238}Pu from ^{241}Am. Plutonium is oxidized to the +4 state while americium remains in the +3 state. This difference in oxidation states allows the extraction of plutonium by bis(2-ethylhexyl) hydrogen phosphate (D2EHPA) into the toluene-based phase of the liquid scintillation cocktail. The americium remains in a 0.15 M HNO_3-dioxane-based cocktail. Differences in scintillation efficiency between phases give rise to spectral peaks that do not overlap and also permit the simultaneous determination of the two isotopes whose energies of emitted α particles differ by only 14 keV. Recoveries for each isotope average better than 95% even when the ratio of one isotope to the other is 10:1.

11792 **Determination of oxygen in molten alkali halide salts by proton activation analysis.** Wai, C.M.; Dysart, M.E. (Univ. of Idaho, Moscow). *Analytical Chemistry;* 58: No. 14, 3266-3269(Dec 1986).

The authors have recently used a lanthanum fluoride precipitation method to separate ^{18}F produced from proton activation of ^{18}O in alkali chloride and fluoride salts. The procedure was developed for studying dissolved oxide species in alkali halide melts. Determination of oxygen in these systems is important for research in batteries and in extractive metallurgy utilizing molten salts as solvents. The details are given oxygen determination in alkali chloride and fluoride systems.

11793 **Analysis of products from reactions of chemisorbed monolayers at smooth platinum electrodes: electrochemical hydrodesulfurization of thiophenol derivatives.** Vieira, K.L.; Zapien, D.C.; Soriaga, M.P.; Hubbard, A.T.; Low, K.P.; Anderson, S.E. (Univ. of California, Santa Barbara). *Analytical Chemistry;* 58: No. 14, 2964-2968(Dec 1986).

The product mixtures from electrochemical hydrodesulfurization of selected thiophenolic compounds chemisorbed through the -SH moiety at smooth Pt electrodes in molar acid have been analyzed quantitatively by using thin-layer electrochemical methods in conjunction with capillary gas chromatography and liquid chromatography. The following compounds were studied: pentafluorothiophenol (PFT), mercaptohydroquinone (MHQ), and 2-mercaptobenzoic acid (MBA). A comparatively high area, large-volume preparative thin-layer electrode (TLE) was constructed to facilitate sample analysis. The results obtained from TLE, GC, and HPLC analysis were in good agreement. The extent of hydrodesulfurization (defined here as simple cleavage of the C-S bond without impairment of the aromatic functionality) depended on the nature of the pendant aromatic ring, decreasing in the order PFT (100%) >> MHQ (50%) >> MBA (15%). Only one desulfurization product was observed for MHQ and MBA; the absence of other products was probably because ring hydrogenation (to form alkyl-type groups) competed with simple desulfurization, and detachment of the alkyl moieties from the -SH anchor occurred with greater difficulty than that of the aromatic group.

11794 **Development of extended X-ray absorption fine structure spectroelectrochemistry and its application to structural studies of transition-metal ions in aqueous solution.** Dewald, H.D.; Watkins, J.W. II; Elder, R.C.; Heineman, W.R. (Univ. of Cincinnati, OH). *Analytical Chemistry;* 58: No. 14, 2969-2975(Dec 1986).

Extended X-ray absorption fine structure (EXAFS) measurements were performed on solutions of various transition-metal complexes. Electrochemical methods were used to generate and maintain the materials in a chosen oxidation state. A spectroelectrochemical cell was constructed with a reticulated vitreous carbon electrode and followed the basic design of an optically transparent thin-layer electrochemical cell. Cell performance was tested on ferrocyanide with chronoamperometry, chronoabsorptometry, and cyclic voltammetry. X-ray absorption spectra of cobalt(III/II) sepulchrate

were examined in a potentiostatic study. Fluorescence EXAFS spectra of $Ru(NH_3)_6^{3+}$ were evaluated for sensitivity enhancement as a function of concentration. Cytochrome c spectra have been recorded and gave a Fe(III)-N distance of 1.97 A and a Fe(II)-N distance of 1.99 A.

11795 **Atomic emission spectrometry with a reduced-pressure afterglow extracted from an inductively coupled plasma.** Houk, R.S.; Lim, H.B. (Iowa State Univ., Ames). *Analytical Chemistry;* **58**: No. 14, 3244-3248(Dec 1986). Contract W-7405-ENG-82.

The inductively coupled plasma (ICP) has proven to be an excellent excitation source for elemental analysis of solutions by atomic emission spectrometry (AES). One reason for the success of the ICP is that volatilization and atomization interferences are minimal because the analyte is efficiently atomized in the high-temperature, atmospheric pressure environment. It seems that such an environment is essential for proper dissociation of analytes from sample particles such as those generated by solution nebulization. In a conventional ICP the analyte atoms then continue through the axial channel where they are excited and ionized at atmospheric pressure. In some ways, the observation of ICP emission at reduced pressure might offer potential advantages in that line widths should be sharper than from an atmospheric pressure source. The same experimental techniques for sampling the ICP for mass spectrometry (MS) should also be useful for AES at reduced pressures. In fact, in ICP-MS the initial extraction process is often accompanied by emission of visible radiation from inside the first vacuum chamber. In addition to potential analytical applications, the observation of emission spectra from such an afterglow could also provide fundamental information about processes occurring during the extraction step, which would be useful for further improvements in ICP-MS. In this communication the authors report for the first time the results of initial investigations that indicate the feasibility of using an analytical ICP at atmospheric pressure for atomization while observing atomic emission spectra at reduced pressure as the analyte species are extracted into a vacuum chamber.

11796 **Characterization of a titanium-promoted supported platinum electrocatalyst.** Beard, B.C.; Ross, P.N. Jr. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Berkeley, CA 94720). *Journal of the Electrochemical Society;* **133**: No. 9, 1839-1844(Sep 1986). Contract AC03-76SF00098.

X-ray photoelectron spectroscopy (XPS), x-ray diffraction (XRD), and extended x-ray adsorption fine structure (EXAFS) were used for the characte3rization of a highly dispersed Ti[promoted Pt electrocatalyst. This bimetallic catalyst was prepared by addition of TiCl/sub 4/ to a methanol-water solution containing Pt on carbon black catalyst in suspension. Following filtration and air drying (300°C), heat-treatments up to 1200°C under flowing helium were performed to promote the formation of Pt-Ti alloy phases. XPS indicated the development of a peak at a binding energy of 454.9 eV (assigned to Ti in Pt/sub 3/Ti), which increased in area with heat-treatment such that after the 1200°C heat-treatment $\approx$ 50% of the Ti was converted to the intermetallic phase, Pt/sub 3/Ti. The Pt (4f, 7/2) photoelectron line shifted (+0.3 eV) to 71.2 eV following the 1200°C heat-treatment, identical to the Pt(4f, 7/2) binding energy for bulk Pt/sub 3/Ti. XRD showed only fcc reflections, indicating the excess Ti present as TiO/sub 2/ was x-ray amorphous. Prior to heat-treatment of the Ti impregnated catalyst, the fcc reflections indicated a lattice parameter of 3.927 A, identical to that for pure Pt. As heat-treatment temperature increased the lattice parameter decreased to 3.906A, the value for bulk Pt/sub 3/Ti. Particle size estimates indicated a progressive increase in the crystallite size of Pt alloy phase with temperature to a final size of B150A at 1200°C. Definitive proof of an ordered Pt/sub 3/Ti phase was the presence of superlattice diffraction lines from materials heated above 900°C. EXAFS of these catalysts confirmed the conversion of an initial Pt-TiO/sub 2/ mixture to Pt/sub 3/Ti at 900°-1200°C heat-treatment temperatures.

11797 **Multiple-quantum nuclear magnetic resonance spectroscopy.** Munowitz, M.; Pines, A. (Amoco Research Center, Naperville, IL). *Science (Washington, D.C.);* **233**: 525-531(1 Aug 1986). Contract AC03-76SF00098.

A nuclear magnetic resonance (NMR) event is popularly viewed as the flip of a single spin in a magnetic field, stimulated by the absorption or emission of only one quantum of radio-frequency energy. Nevertheless, resonances between nuclear spin states that differ by more than one unit in the Zeeman quantum number also can be induced in systems of coupled spins by suitably designed sequences of radio-frequency pulses. Pairs of states excited in this way oscillate coherently at the frequencies of the corresponding multiple-quantum transitions and produce a response that may be monitored indirectly in a two-dimensional time-domain experiment. The pattern of multiple-quantum excitation and response, influenced largely by the concerted interactions of groups of coupled nuclei, simplifies the NMR spectrum in some instances and provides significant new information in others. Applications of multiple-quantum NMR extend to problems in many different areas, ranging from studies of the structure and function of proteins and nucleic acids in solution to investigations of the arrangements of atoms in amorphous semiconductors. The specific spectroscopic techniques are varied as well and include methods designed, for example, to simplify spectral analysis for liquids and liquid crystals, eliminate inhomogeneous broadening, study interatomic connectivity in liquid-state molecules, identify clusters of atoms in solids, enhance the spatial resolution in solid-state imaging experiments, and probe correlated molecular motions. 48 references, 11 figures.

11798 **Partial least-squares methods applied to the quantitative analysis of infrared spectra.** Haaland, D.M.; Thomas, E.V. (Sandia National Labs., Albuquerque, NM 87185). pp 1087 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—). Contract AC04-76DP00789.

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

Partial least-squares (PLS) methods in latent variables have recently been applied to the analysis of near-infrared spectra. The authors present the first application of these methods to the quantitative analysis of mid-infrared spectra. With PLS, the relation between absorbance and concentration is written as the inverse of Beer's law. In order to include all spectral frequencies in the analysis, a data compression is performed and latent factors which both maximize the variance in the calibration spectra and are predictive of concentration are determined for each component included in the analysis. The number of factors to include in the analysis is determined by cross validation. The authors have applied PLS methods to two different systems: 1) binary mixtures of esters (cyclohexyl acetate and ethyl hexanoate) and 2) three components of a seven component glass. The application of PLS to the spectra of eight mixtures of esters yields results which are only slightly greater in error than classical multivariate methods applied to the same data. The ester data are best described by only one PLS factor. The advantage of the PLS method is that only one component need be known to complete the analysis. In the case of eight samples of a seven component silica-based glass, only the B/sub 2/O/sub 3/, P/sub 2/O/sub 5/ and OH components were known. These three components were then analyzed by PLS methods. In this case, PLS yields results slightly more accurate than obtained with classical linear multivariate methods. These results are presented in detail along with a discussion of the potential advantages of PLS techniques over classical least-squares methods.

11799 **The characterization of multilayers analyzers: Models and measurements.** Henke, B.L.; Vejio, J.Y.; Tackaberry, R.E.; Yamada, H.T. (Center for X-Ray Optics, Lawrence Berkeley Lab., One Cyclotron Road, Berkeley, CA 94720). pp 201-215 of Applications of thin film multilayered structures to figured x-ray optics. Vol. 563. Marshall, G.F. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1985). (CONF-850887—). Contract AC03-76SF00098.

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

A procedure is described for the detailed characterization of multilayer analyzers which can be effectively applied to their design, optimization and application for absolute x-ray spectrome-

try. An accurate analytical model has been developed that is based upon a simple modification of the dynamical Darwin-Prins theory to extend its application to finite multilayer systems. Its equivalence to the optical E & M solution of the Fresnel equations at each interface is demonstrated by detailed calculation comparisons for the reflectivity of a multilayer throughout the angular range of incidence of 0 to 90°. A special spectrograph and experimental method is described for the measurement of the absolute reflectivity characteristics of the multilayer. The experimental measurements at three photon energies in the 100-200 eV region are fit by the analytical modified Darwin-Prins equation (MDP) for I(θ), generating a detailed characterization of two "state of the art" multilayers, a sputtered tungsten-carbon of 2d $\approx$ 70 A and a molecular lead separate of 2d $\approx$ 100 A. The fitting parameters that are determined in this procedure are applied to help establish the structural characteristics of the particular multilayer.

11800 **Tandem quadrupole/time-of-flight instrument for mass spectrometry/mass spectrometry.** Glish, G.L.; Goeringer, D.E. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **56**: No. 13, 2291-2295(Nov 1984). Contract W-7405-ENG-26.

A new tandem mass spectrometer for MS/MS studies is described. The instrument consists of a quadrupole mass filter followed by a time-of-flight mass analyzer. A collision cell is located in the region between the two analyzers. Low-energy parent ions (< 100 eV) are mass analyzed by the quadrupole and injected into the collision cell. Daughter ions from collision-activated dissociations (CAD) as well as unfragmented parent ions are accelerated by 1000 eV upon exiting the collision cell. These accelerated ions are then gated into the time-of-flight for mass analysis. Conventional mass spectra may be obtained either by operating the quadrupole in an rf-only mode, where it passes all ions, and using the time-of-flight analyzer or by scanning the quadrupole in the normal fashion and gating the time-of-flight analyzer continually on. Preliminary results are shown and potential improvements and applications are discussed.

11801 **Rotating annular chromatograph for continuous separations.** Begovich, J.M.; Sisson, W.G. (Oak Ridge National Lab., TN). *A.I.Ch.E. Journal (New York);* **30**: No. 5, 705-710(Sep 1984). Contract W-7405-ENG-26.

Preparative, multicomponent liquid chromatographic separations have been achieved by using a slowly rotating annular sorbent bed with fixed multiple feed points and fixed product withdrawal locations. The cation exchange separation of copper, nickel, and two cobalt complexes has been extensively used to study the effects of rotation rate, eluent rate, bed loading, and column size on separation performance. Experimental results have been compared with three theoretical models; plate theory, and analytical solutions which incorporates multicomponent Langmuir isotherms, and an extension of the analytical solution to include dispersion effects.

11802 **Theory of sediment volumes of compressible, particulate structures.** Tiller, F.M.; Khatib, Z. (Univ. of Houston, TX). *Journal of Colloid and Interface Science;* **100**: No. 1, 55-67(Jul 1984). Contract AS05-81ER10946.

Specific sediment volume or its reciprocal, average volume fraction of solids, plays a significant role in determining the state of particle aggregation in a suspension. It is determined by the properties of the rising sediment (or cake) in a batch setting tube. A close relations exists between the sediment volume and sedimentation characteristics involved in design of thickeners and clarifiers. Qualitatively, the average porosity of a particulate bed is shown to be principally a function of particle size, shape, and state of aggregation. Slurry concentration, mechanical agitation, and vibration also affects the state of the sediment. Assuming that porosity is a function of the buoyed weight of solids (effective pressure) and the initial porosity of unstressed sediment, formulas are developed which give the average specific sediment volume as a function of height and bed compressibility. For highly compressible materials, the value of the specific sediment volume changes rapidly with height. The limiting value of the specific sediment volume for a cake with differential thickness or the value of the volume fraction of solids epsilon/sub s0/ for an unstressed bed is probably the best assessing the state of aggregation of a suspension. Two experimental methods are presented for its determination. In the first method, the volume of particulates is plotted as a function of thickness; and the limiting slope for a cake of zero thickness is obtained. In the second method, the initial rates of fall and rise, respectively, of the upper particle-supernatant boundary and the sediment are experimentally measured; and epsilon/sub s0/ is obtained through a material balance. 31 references, 12 figures, 3 tables.

11803 **Fluorescence detection of surface exafs.** Heald, S.M.; Keller, E.; Stern, E.A. (Brookhaven National Lab., Upton, NY). *Physics Letters [Section] A;* **103A**: No. 3, 155-158(25 Jun 1984). Contract AS05-80ER10742;AC02-76CH00016.

The possibilities for fluorescence detection of surface EXAFS are studied using thin films of gold on various substrates. For glancing incidence angles it is found that excellent signal to noise ratios can be obtained even for submonolayer films, demonstrating that the technique should have wide applicability to surface and near surface systems. In many cases the signal to noise is superior to electron detection techniques, and its sensitivity suggests the method may also be useful for detection of trace elements on surfaces. 13 references, 3 figures.

11804 **Potentiometric titration of mercury(II) with cetylpyridinium chloride.** Selig, W.S. (Lawrence Livermore National Lab., CA). *Mikrochimica Acta;* **2**: 455-461(1984). Contract W-7405-ENG-48.

The determination of mercury(II) in acid solutions as well as the assay of mercuric cyanide solutions was required in the Laboratory. In a previous study, the authors found that mercury(II) could be titrated as the tetrachloro complex vs. cetyltrimethylammonium bromide. Subsequently, cetylpyridinium chloride (CPC) was found to be a better titrant because of its higher solubility in aqueous solution. This titrant is inexpensive, relatively non-toxic, and has found numerous applications. In this paper, the authors report the optimum conditions for the potentiometric titration of mercury(II) as the halide complex in acid solution and as the cyano complex in basic solution vs. CPC.

11805 **NMR imaging in solids by multiple-quantum resonance.** Garroway, A.N.; Baum, J.; Munowitz, M.G.; Pines, A. (Lawrence Berkeley Lab., CA). *Journal of Magnetic Resonance;* **60**: 337-341(1984). Contract AC03-76SF00098.

A prototype imaging experiment for solids that relies on the properties of multiple-quantum NMR transitions to increase the effective gradient strength by an order of magnitude is reported. The effect of the gradient upon the evolution of the spin system is intensified by creating high-order multiple-quantum coherences and following their development in the static field gradient. Transitions of many orders are displayed in the studies reported herein; however, in actual imaging schemes, it might be advantageous to use only one order. 21 references, 3 figures.

11806 **Permeation of metal ions through hollow-fiber supported liquid membranes: concentration equations for once-through and recycling module arrangements.** Danesi, P.R. (Argonne National Lab., IL). *Solvent Extraction and Ion Exchange;* **2**: No. 1, 115-120(1984). Contract W-31-109-ENG-38.

Concentration equations are presented for the permeation of metal ions through hollow-fibers supported liquid membranes (SLMs). The equations have been tested for the transport of H^+ and Am^{3+} through SLMs containing trilaurylamine and an alkylphenylcarbamoylmethyl-phosphine oxide as ion carriers.

11807 **Facilitated transport from ternary cation mixtures through water-chloroform-water membrane systems containing macrocyclic ligands.** Izatt, R.M.; Haws, R.M.; Lamb, J.D.; Dearden, D.V.; Brown, P.R.; McBride, D.W. Jr.; Christensen, J.J. (Brigham Young Univ., Provo, UT). *Journal of Membrane Science;* **20**: 273-284(1984). Contract AC02-78ER05016.

Cation fluxes were determined for various three-component, equimolar mixtures of alkali metal, alkaline earth, and Pb^{2+} cations in a H_2O single bond $CHCl_3$ single bond H_2O liquid membrane

system incorporating macrocyclic polyethers as carriers. Carrier ligands studied were 18-crown-6, dicyclohexano-18-crown-6, 1,10-diaza-18-crown-6, 21-crown-7, dibenzo-24-crown-8, and cryptand [2.2.2]. Correlations were found between transport and relative cation:polyether cavity radii, the type of substituents present on the polyether ring, and the type and number of donor atoms present. All the ligands studied transported Pb^{2+} at higher rates than the other M/sup n+/ in the mixtures. Transport behavior in these multi-cation systems can be predicted from M/sup n+/single bond polyether complex stability constant data in most cases. 22 references, 1 figure, 1 table.

11808 **Noble gas detection using resonance ionization spectroscopy and a quadrupole mass spectrometer.** Chen, C.H.; Hurst, G.S. (Oak Ridge National Lab., TN). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* 426: 2-7(1983). Contract W-7405-ENG-26.

The technique of Resonance Ionization Spectroscopy (RIS) is being extended to develop a means for counting individual atoms of a selected isotope of a noble gas. In this method, lasers are used for RIS to obtain atomic species (Z) selectivity and a small quadrupole mass spectrometer provides isotopic (A) selectivity. A progress report on the objective of counting each atom of a particular isotope of a noble gas is given. 11 references, 4 figures.

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REFER ALSO TO CITATION(S) 10718, 10720, 10745, 10751, 10875, 11057, 11870, 11876, 11880, 11882, 11884, 11887, 11897, 12405

11809 **(DOE/ER/05226—4) A study of catalysts and mechanisms in synthesis reactions: Progress report.** Lunsford, J.H. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1986. Contract AS05-76ER05226. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003568.

The focus of research during this period has been on the generation of gas phase radicals at surfaces of catalytic interest. These radicals are believed to be important in such reactions as the oxidative coupling of methane to form ethane, and the coupling of allyl radicals to form the corresponding dimers. In addition, the radicals may serve as chain initiators in homogeneous oxidation reactions. Research also has continued on the catalytic activity of palladium for the synthesis of methanol from carbon monoxide and hydrogen. The role of the support has been previously noted, but is emphasized by recent observations in our laboratory and elsewhere that unsupported palladium is inactive. 5 refs., 2 figs., 2 tabs.

11810 **(DOE/ER/10381—8) Surface composition-reactivity relationships in heterogeneous catalysis: Progress report.** Brenner, A. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). 10 Dec 1986. Contract AC02-79ER10381. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003450.

The primary objectives of the research during the second year of the grant were as follows: (1) Continue work on the temperature programmed reduction and oxidation (TPR/TPO) of supported metals. (2) Determine the activity for H_2-D_2 exchange over Fe_2O_3 as a function of its pretreatment. (3) Attempt to develop a chemisorption technique for measuring the dispersion of supported Mo. (4) Measure the isotopic composition of the products of ethylene deuterogenation over supported Mo. The results are reported in each area of research.

11811 **(DOE/ER/10649—T2) Integrated theoretical and experimental study of the thermophysical properties of fluid mixtures: Annual report.** Haynes, W.M. (National Bureau of Standards, Boulder, CO (USA). Center for Chemical Engineering). Sep 1986. Contract AT01-80ER10649. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003431.

The objectives of this research are to assist the fuel and chemical process industries to improve efficiency and thereby reduce the use of energy and feedstocks and to aid them in the utilization of unconventional feedstocks and energy sources. The objectives are satisfied through the following research efforts: (1) development of predictive procedures for the thermophysical properties of fluids and fluid mixtures; (2) basic understanding of fluid behavior with advances in theory; and (3) acquisition of experimental data to support the theoretical and modeling efforts. The following are what we feel are the most significant results of our recent research: accurate, wide-range, and self-consistent PVT and phase equilibria data are essential to the development of theoretically based predictive models for the behavior and properties of fluid mixtures. We have developed experimental techniques to screen and characterize such systems, as well as techniques for analyzing and reporting data for them. We have made significant studies in experimentally and theoretically determining the sensitivity of theoretical models to the effects of hydrogen bonding. We have learned that non-Newtonian behavior is universal and that common assumptions of fluid behavior must be treated with caution. Most importantly, we have learned that the effect of shear on fluid behavior and properties cannot be ignored. 11 refs., 7 figs., 1 tab.

11812 **(DOE/ER/10855—T1) Effects of dispersion and support on adsorption, catalytic and electronic properties of cobalt/alumina CO hydrogenation catalysts: [Technical progress report].** Bartholomew, C.H. Jr. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 22 Dec 1986. Contract AC02-81ER10855. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003868.

The continued investigation of dispersion and metal-support interactions and their effects upon the adsorption, activity/selectivity, and electronic properties of the metal in cobalt/alumina (and to a lesser extent on iron/alumina) catalysts is proposed. The objectives of this research are to determine the effects of surface structure and metal dispersion on the adsorption and catalytic properties of cobalt, and determine the effects of metal-support interactions, i.e., effects of decorating support species on metal crystallites and of direct electronic interactions between metal clusters and the support, on the adsoprtion, catalytic and electronic properties of cobalt supported on alumina.

11813 **(DOE/ER/13260—8) Adsorption and desorption of hydrocarbons at low concentrations: Performance report for the period 1 June 1984 to 31 December 1986.** Madey, R. (Kent State Univ., OH (USA)). Dec 1986. Contract FG02-84ER13260. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003875.

Research accomplishments during the report period include the following: (1) Derivation of a model for a step increase concentration for a linear chromatographic reactor; (2) Measurement of the transmission curves of stable and radioactive argon and correlation of the moments with analytical expressions; (3) Derivation of the enrichment factor for a pressure swing adsorption system; (4) Studies of the interference of binary mixtures; (5) Calculation of the adsorption isotherms and isosteric heats for three hydrogen gases; (6) Derivation of isotherms for heterogeneous surfaces with micropores and/or mesopores; (7) Application of the adsorption potential to describe the adsorption of hydrocarbons on carbon and polystyrene adsorbents; (8) Determination of the isotherms for binary mixtures on polystyrene, and (9) Correlation of binary adsorption data with single-component isotherms.

11814 **(DOE/ER/13501—T1) Chemical activation of molecules by metals: Experimental studies of electron distributions and bonding: Progress report for year ending February 28, 1987.** Lichtenberger, D.L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). 1986. Contract FG02-86ER13501. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003876.

In the present period we are laying the foundation for a more formal relationship between ionization sutdies and the thermodynamics of metal-assisted chemistry and catalysis. Current applications under study include the principles of carbon-hydrogen bond activation by metals, the cooperative influences of ligand electronic effects, the strengths of metal-carbon bonds, and the electronic principles of olefin and acetylene metathesis and polymerization. Specific research results are reported in the following areas: photolectron spectroscopy of early transition metal bent metallocenes thermodynamic trends and ring methylation effects; nature of

the methyl group as an electronic perturbation of metal-coordinated cyclopentadienyl rings; the correlation of core and valence ionization energy shifts in methyl-substituted ferrocenes; additivity of ligand electronic effects; complete phosphine substitution of group VI metal hexacarbonyls; organometallic methylene-bridged metal dimers; delocalization of metal electron density in metallacycle formation; metal-heteroatom and metal-alkylidyne multiple bonds; and the electronic factors favoring intermediates in acetylene metathesis and polymerization. (PSB)

11815 (DOE/PC/80518—T5) Surface chemistry of model Co-Mo catalysts supported on planar γ-Al_2O_3: Quarterly technical progress report for period September 1, 1986 to November 31, 1986. Sahin, T.; Ford, W.K. (Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering; Montana State Univ., Bozeman (USA). Dept. of Physics). 1986. Contract FG22-85PC80518. 14p. NTIS, PC A02. File Number DE87003704.

This quarter, analysis of the data from a Co-Mo/Al_2O_3 catalyst characterized last quarter by XPS was completed. Preparation of the SIMS/TPD chamber for the adsorption and reaction kinetics studies have continued. The necessary hardware has been purchased and testing of the equipment and computer interface have started. Multichannel detector XPS workstation is being upgraded to do XPS and UPS work. A significant progress has been made on second harmonic generation measurements of single crystal aluminum oxidation. The future work for the next quarter includes the continuation and completion of planar model catalyst development, adsorption studies and continuation of the single crystal aluminum oxidation studies. 4 refs., 2 figs., 2 tabs.

11816 (LA-UR—86-3778) Mechanisms for the deposition of thin metallic films by laser driven gas phase reactions. Jervis, T.R.; Menon, S.K.; Joyce, E.L.; Carroll, D.W. (Los Alamos National Lab., NM (USA); Naval Chemical and Metallurgical Lab., Bombay (India)). 1986. Contract W-7405-ENG-36. 6p. (CONF-861207—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002919.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Gas phase processing makes laser deposition over large areas possible but homogeneous nucleation of large atomic clusters must be avoided if films are to be produced. Clusters can be highly variable in size from a few atoms to significant fractions of a micrometer. If conditions do not allow for complete quenching of the clusters produced in the gas phase, these clusters can arrive at the substrate with sufficient energy to self sinter into homogeneous films which are substantially different from metallic films grown by thermal techniques. Using transmission electron microscopy (TEM), we have characterized the microstructure of thin metallic films deposited by laser breakdown chemical vapor deposition and identified a range of deposition conditions which can lead from powders to homogeneous polycrystalline films and mixed phase materials. Gas phase nucleation is dependent on reactant partial pressures and the gas phase quench rate which can be varied in part by adjusting the H_2 content of the source gas. Manipulation of these parameters can vary powder size from about one micrometer to less than 2 nanometers. Variation of the quench rate during the deposition of polycrystalline films varies the grain size in the films. Heating the substrate drastically changes the conditions under which the film is formed and as a consequence, can radically alter the microstructure of the film itself. 6 refs., 2 figs.

11817 (LBL—22126) Model catalytic systems: Reactions of small molecules (C_4H_9OH, NH_3,CO,H_2) on transition metal surfaces. Naasz, B. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87003453.

This thesis is comprised of the study of two different catalytic reactions. The first being the ammonolysis of n-butanol over model Rh(111), Rh(331), and Cu(111) single crystal surfaces. The second is the hydrogenation of CO over well defined Fe and Re polycrystalline foils and unsupported MoS_2 catalysts. These studies combine kinetic characterization and these catalytic systems and surface analysis of the catalysts used.

11818 (N—87-11671) Ammonia-water phase diagram and its implications for icy satellites. Johnson, M.L.; Nicol, M. (California Univ., Los Angeles (USA)). 1986. 53p. (NASA-CR—179881; NAS—1.26:179881). NTIS, PC A04/MF A01.

A Holzapfel-type diamond anvil cell is used to determine the NH_3 - H_2O phase diagram in the region from 0 to 33 mole percent NH_3, 240 to 370 K, and 0 to 5 GPa. The following phases were identified: liquid; water ices Ih, III, V, VI, VII, and VIII; ammonia monohydrate, $NH_3.H_2O$; and ammonia dihydrate $NH_3.^2H_2O$. Ammonia dihydrate becomes prominent at moderate pressures (less than 1 GPa), with planetologically significant implications, including the possibility of layering in Titan's magma ocean.

11819 (NIPER—188) Thermochemical and thermophysical properties of organic nitrogen compounds found in fossil materials: Status report. Steele, W.V.; Chirico, R.D.; Collier, W.B.; Hossenlopp, I.A.; Nguyen, A.; Strube, M.M. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Nov 1986. Contract FC22-83FE60149. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001204.

Thermochemical and thermophysical data on 24 organic nitrogen-containing compounds found in (or formed during the processing of) alternate fossil fuels are reported here. The data are combined to give ideal gas phase thermodynamic properties for 18 of the compounds. Statistical thermodynamic calculations for six of the compounds are given, and a comparison of statistically calculated values (including those previously published) and the calorimetric values obtained here is made. The results are used to determine the thermodynamic equilibrium conditions necessary for the removal of the nitrogen atom from the molecules. The report concludes with a discussion of future research in the area. This report is the first comprehensive compilation of thermochemical and thermophysical property data on organic nitrogen compounds present in the alternate fossil fuels. Removal of these compounds during processing is necessary for the production of stable, environmentally acceptable products. 71 refs., 11 figs., 13 tabs.

11820 (ORNL—6261, pp 24-45) Aqueous chemistry at high temperatures and pressures. May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

Studies of chemical equilibria and thermodynamic properties of electrolyte solutions at high temperatures and pressures are the concern of this program. Results help establish bases for fundamental understanding of chemical reactivity and its predictability. Recent emphasis has been given to the application of non-interaction models to the excess thermodynamic properties of HCl(aq), alkali metal sulfates and some salts of carbonic acid and boric acid. Experimental results are reported for calorimetric measurements of the enthalpy of dilution of NaOH(aq) and isopiestic measurements on mixed electrolytes. A model with three additive contributions to the excess gibbs energy of mixing has been applied to very concentrated multicomponent electrolytes. Potentiometric techniques have been applied to the identification of species and measurement of equilibrium quotients in the chromium(VI)(aq) system and for measurement of the quotients for the dissociation of water in a non-complexing medium. An evaluation of the electrical conductance of water to 1000°C and a model for the activity of water over electrolyte and non-electrolyte solutions based on a modification of Raoult's Law are reported. Recent results on the effects of dioxane on two-liquid phase behavior in phosphate systems, spectral and kinetics studies on HOI(aq), and the description of a new Raman cell for high temperatures and pressures complete the section.

11821 (ORNL—6261, pp 46-68) Geochemistry. May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

This program has research efforts in three interrelated disciplines: igneous petrology, hydrothermal geochemistry, and stable isotope geochemistry. The principal contributions of this program have come from experimental studies using a wide array of unique equipment. In the past year, however, a significant portion of this

program has been devoted to field studies in volcanic terranes of California and New Mexico and in crystalline rocks of the southern Appalachians. This temporary focus on field projects was motivated by opportunities to play an important role in the Continental Scientific Drilling Program and to broaden our scope through collaboration with field geologists. Our experimental program has been stimulated by these recent field studies and continues with the essential goal of understanding geological processes by integrating fundamental data from experimental studies with accurate physical and chemical models. 44 refs., 16 figs., 1 tab.

11822 (ORNL—6261, pp 138-154) **Catalysis.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

The redox characteristics of selected arenes and heterocyclic aromatics in liquid EMI(Al_2Cl_7) (EMI = 1-ethyl-3-methyl-1H-imidazolium cation) at 25°C were investigated by means of cyclic voltammetry and optical spectroscopy. For purposes of this investigation a synthesis was developed for EMICl which upon reaction with $AlCl_3$ yielded liquid EMI(Al_2Cl_7) of exceptional purity (0.1 to 0.2 mM protic impurities, no perceptible oxidizing impurities). The catalytic decomposition chemistry of naphthalene (Na), pyrene (Py), An, naphthacene (Nc), 9,10-dihydroanthracene (DHA), and diphenylmethane (DPM) in molten $AlCl_3$-NaCl-KCl (60-26-14 m/o) at 120°C was investigated by means of ESR, ^{1}H-NMR and quench and separation procedures. A program to study structure and catalytic properties of solid surfaces is described. This program at present incorporates two approaches. One approach, still in technical development, has the ultimate goal of correlating catalytic reactivity and selectivity under realistic conditions with the structure and composition of the model catalytic surfaces as determined by using various surface analytical techniques. An apparatus, now nearly complete, has been developed for this purpose and is described. A second part of this program, which has been in progress for several years, focuses on the application of low energy alkali ion scattering as a probe of surface structure. The use of this technique to study surface layer relaxation on clean Mo(111) and to characterize adsorption of S on Mo(111) are described. Previous ion scattering studies of amorphous metal surfaces have led to further x-ray photoemission and Auger electron spectroscopic characteristics of these surfaces as discussed herein. Finally, initial experiments to use multicharged ions as novel probes of surface properties are discussed. 36 refs., 4 figs., 7 tabs.

11823 **Theoretical basis for line number to line intensity logarithmic relationship.** Scheeline, A. (Univ. of Illinois, Urbana). *Analytical Chemistry;* **58**: No. 14, 3103-3108(Dec 1986). Contract FG02-84ER13218.

A linear relationship between the logarithm of the number of lines having a given spectral intensity and the logarithm of the relative intensity of those lines with respect to the weakest observable lines in the spectrum is critically evaluated. Use of exact quantum mechanical formulas for electric dipole transitions in hydrogen allows simulation of spectral behavior that can be generalized to elements whose spectra can be described in the Russel-Saunders limit. The linear relationship is shown to be of narrower applicability than originally conceived. Some apparent anomalies in literature data are explained. Results are discussed in terms of interferences expected from line overlaps in emission spectrochemical analysis.

11824 **Single crystal neutron diffraction refinement of bullvalene at 110 K.** Luger, P.; Buschmann, J.; McMullan, R.K.; Ruble, J.R.; Matias, P.; Jeffrey, G.A. (Freie Universitaet Berlin, West Germany). *Journal of the American Chemical Society;* **108**: No. 24, 7825-7827(26 Nov 1986). Contract AC02-76CH00016.

A low-temperature neutron diffraction refinement of the crystal structure of bullvalene, $C_{10}H_{10}$, tricyclo[3.3.2.0/sup 2.8/]deca-2,5,8-triene, shows that the molecule is distorted only very slightly from the C/sub 3 upsilon/ symmetry expected for the isolated molecule, although the crystal structure symmetry is monoclinic. There is a small but significant difference between the shortest and longest of the C-C bonds in the cyclopropane ring, which are 1.536 (1), 1.533 (1), and 1.530 (1) A. The three ethylenic wings of the molecule are virtually identical, except for small differences in planarity and C-C-H angles. One wing is exactly planar within 0.002 (3) A. In the other two, one of the hydrogen atoms in each is significantly displaced from the plane by 0.027 (3) and 0.023 (3) A. The mean bond lengths in the ethylenic wings are C/sub ring/-C, 1.4727 (7) A; C=C, 1.3423 (7) A; =C-C, 1.5163 (7) A. The C-H bond lengths range from 1.086 (2) to 1.092 (2) A. The thermal motion analysis gives an unusually good fit to the rigid-body model. Corrections for harmonic thermal motion lengthened all C-C and C=C bonds uniformly by 0.003 A. For the C-H bonds, the harmonic riding motion and anharmonicity corrections almost cancel, so that the thermally corrected bond lengths differ from those measured by +/- 0.001 A.

11825 **Hydrogen-atom abstraction from alkanes by OH. 4. Isobutane.** Tully, F.P.; Goldsmith, J.E.M.; Droege, A.T. (Sandia National Labs., Livermore, CA). *Journal of Physical Chemistry;* **90**: No. 22, 5932-5937(23 Oct 1986).

Absolute rate coefficients for the reactions of the hydroxyl radical with four selectively deuterated isotopes of isobutane were determined by using the laser photolysis/laser-induced fluorescence technique. Kinetic data were obtained at a pressure of 400 Torr of helium over the temperature range 293-864K. Rate coefficient results for the OH + i-C_4H_{10} → H_2O + C_4H_9 reaction are fit by the modified Arrhenius expression $k_1(T) = (4.31 \times 10^{-17})$T/sup 1.80/ exp(+348 cal mol^{-1}/RT) cm^3 $molecule^{-1}s^{-1}$. The authors find that the reactivity of an individual methyl or methylidyne group in isobutane is independent of the hydrogen isotopic content of the remaining alkyl groups in the molecule. Branching ratios for formation of tert-butyl and isobutyl radicals are presented as functions of temperature; abstraction of a tertiary hydrogen atom dominates the reactivity at room temperature, and abstraction of primary hydrogen atom is favored at 1000 K. The kinetic isotope effect for tertiary H- and D-atom abstraction from isobutane by OH is characterized.

11826 **Structures and fundamental vibrations of p-benzoquinone and p-benzosemiquinone radical anion from ab initio calculations.** Chipman, D.M.; Prebenda, M.F. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **90**: No. 22, 5557-5560(23 Oct 1986).

Properties of the ground electronic states of neutral p-benzoquinone and the related p-benzosemiquinone radical anion are determined by ab initio calculations. The structures, vibrational frequencies, and frequency assignments of the neutral are found to be in good agreement with the most recent experimental determinations. Good agreement is also found for the few anion frequencies known experimentally. The calculations provide new information on the structure of the anion as well as on its other vibrational modes. Significant differences between the neutral and anion can be explained on the basis of weakening of the C=O and C=C bonds and strengthening of the C-C neutral bonds upon electron attachment.

11827 **Optical dephasing of impurity transitions in amorphous solids from diagnoal modulation: application of nonphenomenological distribution functions.** Jankowiak, R.; Small, G.J. (Iowa State Univ., Ames). *Journal of Physical Chemistry;* **90**: No. 22, 5612-5615(23 Oct 1986).

The diagonal modulation mechanism for optical dephasing of impurity transitions in amorphous solids is reexamined by utilizing nonphenomenological distribution functions for the two-level systems (TLS). With reasonable variations in the distribution function parameters, it is shown that the power law Δomega proportional to T/sup n/ with 1.2 approximately ≦ n approximately ≦ 2 holds for a dipole-dipole interaction. However, off-diagonal modulation provides the same range in n. The problem of distinguishing between dephasing mechanisms is discussed.

11828 **Small-angle neutron scattering from hexadecyltrimethylammonium bromide micelles in aqueous solutions.** Berr, S.S. Caponetti, E.; Johnson, J.S. Jr.; Jones, R.R.M.; Magid, L.J. (Wake Forest Univ., Winston-Salem, NC). *Journal of Physical Chemistry;* **90**: No. 22, 5766-5770(23 Oct 1986). Contract AC05-84OR21400.

Small-angle neutron scattering measurements have been carried out at 50°C as a function of external contrast (different ratios of H_2O to D_2O) on 0.12 M solutions of hexadecyltrimethylammonium bromide, with the methyls of the ammonium group protiated and deuterated. The results indicate that most of the surfactant hydrocarbon is in a micellar core penetrated by little, if any, solvent. The micelles are described adequately by a dispersion of monodisperse prolate ellipsoids. There is a significant effect on the size of the aggregates by the isotopic composition of the solvent.

11829 **Electron energy loss and thermal desorption spectroscopy of pyridine adsorbed on Pt(111).** Grassian, V.H.; Muetterties, E.L. (Lawrence Berkeley Lab., CA). *Journal of Physical Chemistry;* **90**: No. 22, 5900-5907(23 Oct 1986). Contract AC03-76SF00098.

The chemisorption behavior of pyridine (NC_5H_5) on a Pt(111) surface has been examined by using thermal desorption and electron energy loss spectroscopy as a function of adsorption temperature. The vibrational spectrum of pyridine adsorbed to room temperature on this surface shows intense loss peaks in the specular direction from vibrational modes which can be characterized as in-plane stretching and bending modes. This vibrational spectrum has been interpreted as the formation of an α-pyridyl species (NC_5H_4) on the surface. The pyridyl moiety is bonded to the platinum surface through the nitrogen and one of the α-carbon atoms with the pyridyl plane perpendicular to the metal surface. When pyridine is adsorbed at low temperature (120 K), it bonds to the surface through both the nitrogen atom and the π and π/sup */ orbitals of the pyridine ring. As the crystal is warmed to 260 K, at saturation coverage, approximately 50% of the molecules desorb as molecular pyridine. The remaining pyridine molecules partially decompose on the surface to form an α-pyridyl fragment. The electron energy loss spectra of pyridine adsorbed at both low and room temperature is compared to the infrared spectra of two osmium cluster compounds: $Os_3(CO)_{11}(NC_5H_5)$, a pyridine complex, and $HOs_3(CO)^{18}NC_5H_4$), a pyridyl complex.

11830 **Hydrogen-atom abstraction from alkanes by OH. 5. n-Butane.** Droege, A.T.; Tully, F.P. (Sandia National Labs., Livermore, CA). *Journal of Physical Chemistry;* **90**: No. 22, 5937-5941(23 Oct 1986).

Absolute rate coefficients for the reactions of the hydroxyl radical with n-butane (k_1) and n-butane-d_{10} (k_2) were determined by using the laser photolysis/laser-induced fluorescence technique. Kinetic data were obtained at a pressure of 400 Torr of helium over the temperature ranges 294-509 K (k_1) and 294-599 (k_2). Rate-coefficient results are fitted to the modified Arrhenius expressions $k_1(T) = (2.34 \times 10^{-17})T/sup\ 1.95/\ exp(+267\ cal\ mol^{-1}/RT)\ cm^3\ molecule^{-1}s^{-1}$ and $k_2(T) = (2.92 \times 10^{-18})T/sup\ 2.20/\ exp(+65\ cal\ mol^{-1}/RT)cm^3\ molecules^{-1}s^{-1}$. Utilizing results of previous OH + alkane studies, the authors determine site-specific rate coefficients for H- and D-atom abstraction by OH from the methyl and methylene groups in n-butane. The kinetic isotope effect for abstraction of H- and D-atoms from the methylene sites in n-butane is characterized, and it is found to be very similar to that measured for H- and D-atom transfer to OH from the secondary site in propane.

11831 **Electron- and photon-stimulated desorption: probes of structure and bonding at surfaces.** Madey, T.E. (National Bureau of Standards, Gaithersburg, MD). *Science (Washington, D.C.);* **234**: 316-322(17 Oct 1986).

Techniques for analyzing the structure and composition of solid surfaces with electron and photon beams often cause radiation damage in samples. Damage-producing processes compete with information-producing events during measurements, and beam damage can be a series perturbation in quantitative surface analysis. There are, however, substantial benefits of electron- and photon-stimulated damage processes for studying molecules adsorbed on surfaces. Direct information about the geometric structure of surface molecules can be obtained from measurements of the angular distributions of ions released by electron- or photon-stimulated desorption. The directions of ion emission are determined by the orientation of the surface bonds that are ruptured by beam irradiation. Moreover, photon-stimulated desorption studies that make use of synchrotron radiation reveal the fundamental electronic excitations that lead to bond-breaking processes at surfaces. These measurements provide new insights into radiation-damage processes in areas as diverse as x-ray optics and semiconductor electronics.

11832 **Influence of orientational fluctuations on electron transfer in systems of donor-acceptor pairs.** Domingue, R.P.; Fayer, M.D. (Stanford Univ., CA). *Journal of Physical Chemistry;* **90**: No. 21, 5141-5146(9 Oct 1986). Contract FG03-84ER13251.

The authors present model calculations on the influence of fluctuations in the relative orientation of a donor and acceptor pair held at fixed separation on electron-transfer observables. A simple model of the angular dependence of the transfer rate based on the overlap of a S orbital with a P orbital is used, and a variety of angular fluctuation distribution functions are employed. The effect on observables is calculated for electron transfer which is fast relative to the fluctuations and which is slow relative to the fluctuations. It is demonstrated that the extent and geometry of the fluctuations can have a significant effect on electron transfer even though the donor and acceptor are held at fixed separation.

11833 **Spectrophotometric and X-ray absorption edge study of complexation of carbon monoxide with ferric tetrasulfophthalocyanine in alkaline solution.** Linkous, C.A.; O'Grady, W.E.; Sayers, D.; Yang, C.Y. (Brookhaven National Lab., Upton, NY). *Inorganic Chemistry;* **25**: No. 21, 3761-3765(8 Oct 1986). Contract AC02-76CH00016;AS05-80ER10742.

The square-planar macrocyclic chelate ferric tetrasulfophthalocyanine ($C_{32}H_{12}N_8(SO_3)_4Na_4Fe$) was found to reversibly complex carbon monoxide in anaerobic, alkaline solution. The complex gave an electronic spectrum substantially different from that normally observed in solution for phthalocyanines, suggesting a redox process involving the organic ring. Reexposure to O_2 generated an intermediate species that exhibited a normal electronic spectrum. By comparison of the X-ray absorption edge spectra of the complexed iron in the various stages of reaction to its oxide powders, the changes between ferric and ferrous oxidation states could be monitored. Results suggest that the combined effect of CO and hydroxide on the Fe center is to lower the unfilled d/sub xy/ orbital below the filled a /sub lu/ orbital of the phythalocyanine ligand, enabling reduction of ferric ion to the ferrous state by the macrocyclic ring. 52 references, 5 figures, 1 table.

11834 **Standard Chemical Thermodynamic Properties of Alkyne Isomer Groups.** Alberty, R.A.; Burmenko, E. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Physical and Chemical Reference Data;* **15**: No. 4, 1339-1349(Oct 1986).

The chemical thermodynamic properties of alkyne isomer groups from C_2H_2 to C_5H_8 in the ideal gas phase have been calculated from 298.15 to 1000 K from tables of Stull, Westrum, and Sinke. In the absence of literature data on all isomers of higher isomer groups, the properties of isomers of C_6H_{10} to C_6H_{14} have been estimated using Benson group values. Equilibrium mole fractions within isomer groups have been calculated for the ideal gas state from 298.15 to 1000 K. For isomer group properties, increments per carbon atom have been calculated to show the extent to which thermodynamic properties of higher isomer groups may be obtained by linear extrapolation. Values of C/sup circle-open//sub P/, S/sup circle-open/, Δ/sub f/H/sup circle-open/, and Δ/sub f/G/sup circle-open/ are given for all species from C_2H_2 to C_6H_{14} in SI units for a standard state pressure of 1 bar.

11835 **Oxidative and electrophilic pathways in the reactions of pentaaquo(organo)chromium(2+) ions with nitrous acid.** Melton, J.D.; Bakac, A.; Espenson, J.H. (Iowa State Univ., Ames). *Inorganic Chemistry;* **25**: No. 19, 3360-3367(10 Sep 1986). Contract W-7405-ENG-82.

The reactions of HONO with $(H_2O)_5CrR^{2+}$ complexes occur with a 1:1 stoichiometry at rates ranging from 0.12 (R = CH_2Br) to 1010 $M^{-1}\ s^{-1}$ (R = rho-$CH_2C_6H_4CH_3$). The chromium product is $Cr(H_2O)_6^{3+}$ for R = alkyl, haloalkyl, and aralkyl but the kinetically stable nitrosyl complex $(H_2O)_5CrNO^{2+}$ for R = α-hydroxy- and α-alkoxyalkyl. All of the reactions are believed to proceed by a

bimolecular reaction between the nitrosyl cation NO^+ and CrR^{2+}. In the case of the aralkyl complexes, the data are consistent with an electrophilic process; correlations with data in the literature support the assignment of an S/sub E/2 mechanisms. The other reactions are best interpreted in terms of electron transfer to form CrR^{2+}. The fate of the latter depends on the nature of the group R. Intramolecular electron transfer for R = CH_2OH, CH_2OCH_3, and $CH(C\text{-}H_3)OC_2H_5$ results in Cr^{2+}, which is scavenged by NO to give $CrNO^{2+}$. The rate constant for the reaction between Cr^{2+} and NO has been independently evaluated as 2.2 x 10^6 M^{-1} s^{-1} by competition methods. All the other CrR^{2+} complexes decompose by homolysis. The free radical so formed reacts with NO to yield RNO. 57 references, 7 figures, 3 tables.

11836 Electron-transfer reactions of technetium complexes. 1. Rate of the self-exchange reaction of the Tc(I)/Tc(II) couple [Tc(DMPE)$_3$/sup +/2+/, where DMPE = 1,2-bis(dimethylphosphino)ethane. Doyle, M.N.; Libson, K.; Woods, M.; Sullivan, J.C.; Deutsch, E. (Univ. of Cincinnati, OH). *Inorganic Chemistry;* **25**: No. 19, 3367-3371(10 Sep 1986). Contract W-31-109-ENG-38.

The rate of the self-exchange electron-transfer reaction between $[Tc(DMPE)_3]^+$ and $(Tc(DMPE)_3]^{2+}$ has been determined by two independent applications of the Marcus theory. The rates and equilibrium constants governing the cross-reactions between [Tc(DMPE)$_3$]/sup +/2+/ and [$(NH_3)_5$RuL]/sup 2+/3+ (L = isonicotinamide, pyridine, 4-picoline) were measured in aqueous LiCl/HCl solutions. The known self-exchange rate of [$(NH_3)_5$Ru(py)]/sup2+/3+/ was then used within the Marcus cross relationship to calculate three values of k/sub ex/ for [Tc(DMPE)$_3$]/sup =/2+/. These values fall within the range (0.8-4.0) x 10^6 M^{-1} s^{-1} (25 °C, μ = 0.10 M). Estimated activation parameters for this reaction are ΔH/sub ex//sup */ = 7 +/- 3 kcal/mol and ΔS/sub ex//sup */ = -8 +/- 4 eu. Available bond length data show that, because of extensive π-back-bonding from Tc to P, the Tc-P bond expands by about 0.068 A upon oxidation of the technetium center. This information combined with estimates for the radius of the complex (4.8 A) and for the force constant of the Tc-P bond (1.64 x 10^5 dyn/cm), can be used within the Marcus formalism to calculate k/sub ex/. The resulting calculated value is 3 x 10^6 M^{-1} s^{-1} (25°C), in excellent agreement with the median value determined kinetically. This agreement between kinetically and structurally determined values of k/sub ex/ demonstrates that the self-exchange reaction of the extensively π-back-bonded (Tc(DMPE)$_3$]/sup +/2+ system is adequately described within the Marcus formalism. Moreover, the value of k/sub ex/ for this d^6/d^5 couple is in good agreement with the value of k/sub ex/ (2.2 x 10^6 M^{-1} s^{-1}; 25°X, μ = 0.10 M) observed for [$(NH_3)_4$Ru(bpy)]/sup 2+/3+/, a predominantly σ-bonded d^6/d^5 couple of similar radius (4.4 A).

11837 Thermodynamics of complexation of lanthanides by 3-fluoro-, 4-fluoro-, and 3-nitrobenzoic acids. Choppin, G.R.; Lajunen, L.H.J. (Florida State Univ., Tallahassee). *Inorganic Chemistry;* **25**: No. 19, 3512-3514(10 Sep 1986).

The thermodynamic parameters (log β_{181}, and ΔH_{181}) for the formation of the LnL^{2+} complexes between lanthanide cations and 3-fluoro-, 4-fluoro, and 3-nitrobenzoate anions (L^-) were determined by potentionmetric and calorimetric titrations in 0.10 M ($NaClO_4$) ionic strength aqueous solution at 25°C. The stabilities of the present complexes agreed with the relationship for monocarboxylate complexation (e.g. log β_{181} vs. log K_{811}). 7 references, 2 figures, 5 tables.

11838 Insertion of $SnCl_2$ into an Os-Os bond of $Os_3(CO)_{11}(\mu\text{-}CH_2)$ to give the planar cluster $Os_3SnCl_2(CO)_{11}(\mu\text{-}CH_2)$ with a pentacoordinate tin atom. Viswanathan, N.; Morrison, E.D.; Geoffroy, G.L.; Geib, S.J.; Rheingold, A.L. (Pennsylvania State Univ., University Park). *Inorganic Chemistry;* **25**: No. 17, 3100-3102(13 Aug 1986).

Studies have revealed that the planar cluster compounds, $Os_3SnCl_3(CO)_{11}(\mu\text{-}CH_2)$, is formed by the insertion of $SnCl_2$ into the Os-Os bond when $SnCl_2$ reacts with $Os_3(\mu\text{-}Ch_2)(CO)$. The cluster compound was characterized spectroscopically and defined by x-ray diffraction studies. 13 references, 1 figure, 1 table.

11839 Generation and reactions of chiral, pyramidal, transition-metal Lewis acids of the formula [(eta^5-C_5H_5)Re(NO)(PPh$_3$)]$^+$ X$^-$. Fernandez, J.M.; Gladysz, J.A. (Univ. of Utah, Salt Lake City). *Inorganic Chemistry;* **25**: No. 16, 2672-2674(30 Jul 1986).

The synthesis of BF_4^- and PF_6^- complexes of the pyrimidal coordinatively unsaturated cation $[(eta^5\text{-}C_5H_5)Re(NO)(PPh_3)]^+$ is described. Reactions that illustrate the utility of these compounds as precursors to a variety of complexes of the types [(eta^5-C_5H_5)Re(NO)(PPh$_3$)(L)]$^+$ and (eta^5-C_5H_5)Re(NO)(PPh$_3$)(X) are also presented. Proof is presented for the generation of these compounds in enatiometrically pure form providing the first observable transition-metal Lewis acids that are optically active and have metal-centered chirality. 16 references, 2 figures.

11840 Coordination mode of tris(2-pyridyl)carbinol to cobalt(III): crystal structure of Li[Co{(2-py)$_3$COH}$_2$](S$_2$O$_8$)$_2$ x 10H$_2$O. Szalda, D.J.; Keene, F.R. (Brookhaven National Lab., Upton, NY). *Inorganic Chemistry;* **25**: No. 16, 2795-2799(30 Jul 1986). Contract AC02-76CH00016.

The bis[tris(2-pyridyl)carbinol]cobalt(III) complex was isolated as either of two linkage isomers, dependent on conditions of synthesis. A symmetrical form has all donor atoms being py N (i.e.((py)$_3$COH-N,N',N'')$_2$), while the unsymmetrical form has one deprotonated ligand which is coordinated through two py N atoms and the alkoxy O (i.e. ((py)$_3$COH-N,N',N'')((py)$_3$CO$^-$-N,N',O)). The X-ray crystal structure of the symmetrical form as Li[Co{(2-py)$_3$COH}$_2$](S$_2$O$_8$)$_2$ x 10H$_2$O is reported: the complex of formula $C_5{}^2H_{46}N_6O_{34}S_4LiCo$ is monoclinic, space group C2/c, β = 109.88 (2)°, with cell dimensions a = 19.177 (6) A, b = 10.533 (2) A, c = 23.390 (7) A, and Z = 4 The cation has the six pyridine N atoms coordinated to the metal center in almost perfect octahedral geometry (Co(III)-N bond distances range between 1.931 (3) and 1.944 A). Electrochemical studies of this symmetric linkage isomer reveal similarities to the [Co(bpy)$_3$]/sup n+/ species, with both the Co(III)/Co(II) and Co(II)/Co(I) redox couples apparent on the cyclic voltammetric time scale. 29 references, 2 figures, 3 tables.

11841 Electrochemical, spectral, and base-binding studies of heterodinuclear ruthenium-iron complexes of meso-$\alpha,\alpha,\alpha,\alpha$-tetrakis(nicotinamidophenyl)porphine. Elliott, C.M.; Arnette, J.K. (Colorado State Univ., Fort Collins). *Inorganic Chemistry;* **25**: No. 16, 2867-2872(30 Jul 1986). Contract AC02-81ER10968.

Electrochemical, spectral, and base-binding studies have been carried out on the heterodinuclear complex $RuCl_3((nic)_4Fe$/sup III/TPP)Cl in DMF solution where (nic)$_4$Fe/sup III/TPP is the ligand (meso-tetrakis(o-nicotinamidophenyl)porphyrin)iron(III). The $RuCl_3(nic)_4$ moiety has both electronic and steric effects on the iron center. Despite steric restrictions both the Fe(II) and Fe(III) forms can bind two 1-methylimidazole molecules at the iron center, one occupying the external axial site and one occupying the internal axial site. Additionally, this complex constitutes the first solution electrochemical evidence for nitrogen base binding to a Fe(I) porphyrin. 13 references, 11 figures, 3 tables.

11842 Bidentate and unidentate formato ligands in Mo(CO)$_2$(PEt$_3$)$_2$(O$_2$CH)$_2$. Brower, D.C.; Winston, P.B.; Tonker, T.L.; Templeton, J.L. (Univ. of North Carolina, Chapel Hill). *Inorganic Chemistry;* **25**: No. 16, 2883-2888(30 Jul 1986). Contract FG05-85ER13430.

Syntheses and spectroscopic properties of complexes of the type M(CO)$_2$L$_2$(B-B)Y are presented [M = Mo, W; L = PEt_3, PPh_3; B-B = acetylacetonate (acac), 1,1,1,5,5,5-hexafluoroacetylacetonate (facfac), tropolonate (trop), carboxylate; Y = Cl, Br, O_3CR]. These products are derived from M(CO)$_3$L$_2$X$_2$ reagents (X = Cl, Br). The x-ray diffraction structure of one member of this series, Mo(CO)$_2$(PEt$_3$)$_2$(OOCH)$_2$ (2), is described. The molecule crystallizes in the monoclinic space group $P2_1/n$ with a = 12.691 (8) A, b = 12.250 (9) A, c = 13.813 (12) A, β = 90.85 (6)°, and Z = 4. The structure was solved from 3410 reflections with $I > 3\alpha(I)$, with weighted and unweighted residuals of 5.4 and 4.1%, respectively. The formato ligands engage in different binding modes in the solid state. These ligands exchange unidentate and bidentate coordination modes rapidly in solution with an activation barrier

too small to be readily measured by variable-temperature NMR techniques. 26 references, 1 figure, 7 tables.

11843 EXAFS evidence for direct metal-metal bonding in reduced Rh/TiO_2 catalysts. Sakellson, S.; McMillan, M.; Haller, G.L. (Yale Univ., New Haven, CT). *Journal of Physical Chemistry;* **90**: No. 9, 1733-1736(24 Apr 1986). Contract AC02-81ER10829.

An EXAFS analysis of a reduced Rh/TiO_2 catalyst prepared by ion exchange demonstrates that direct Rh-Ti bonding is produced by reduction at 773 K. The bond length for Rh-Ti formed in the catalyst is significantly shorter than that observed in the most stable intermetallic between the two elements, RhTi. This is taken as evidence that Ti (and perhaps Rh) has some cationic character, presumably as a result of association with oxygen. 24 references, 6 figures, 1 table.

11844 Methylene: a paradigm for computational quantum chemistry. Schaefer, H.F. III. (Univ. of California, Berkeley). *Science (Washington, D.C.);* **231**: 1100-1107(7 Mar 1986).

The year 1970 has been suggested as a starting date for the third age of quantum chemistry, in which theory takes on not only qualitative but also quantitativ value. In fact, each of the years 1960, 1970, 1972, and 1977 is of historical value in the unraveling of the structure and energetics of the CH_2 molecule, methylene. What took place for methylene, namely the establishment of credibility for theory, has subsequently taken place for many other molecules. Three important roles for quantitative theory are outlined: (1) theory precedes experiment, (2) theory overturns experiment, as resolved by later experiments, and (3) theory and experiment work together to gain insight that is afforded independently to neither. Several examples from each of the three classes are given. 146 references, 1 figure.

11845 Cobalt-catalyzed one-step assembly of B-ring aromatic steroids from acyclic precursors. Lecker, S.H.; Nguyen, N.H.; Vollhardt, K.P.C. (Univ. of California, Berkeley). *Journal of the American Chemical Society;* **108**: No. 4, 856-858(19 Feb 1986).

Because of their varied physiological activity, steroids are important testing grounds on which to explore the utility of novel synthetic methodology. In this study cobalt, in the form of $CpCo(CO)_2$ is used as a matrix around which to assemble natural and unnatural polycyclic products, including the steroid nucleus. In this way, the total synthesis of A-ring aromatic systems of the estrone type was achieved via the D → ABCD and A → ABCD strategies. An approach is reported here in which all four rings are assembled (0 → ABCD) in one step to give B-ring aromatic derivatives with complete control of the crucial stereochemistry of the C,D-ring juncture. This strategy has been accomplished previously only by employing biomimetic cyclizations and not en route to the rate target class of compounds which has never been constructed by total synthesis. 13 references, 1 table.

11846 Transition-metal cluster ions in the gas phase. Oxide chemistry of dimeric and trimeric clusters containing iron and cobalt. Jacobson, D.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **108**: No. 1, 27-30(8 Jan 1986). Contract AC02-80ER10689.

The oxide chemistry of both dimeric and trimetric transition-metal cluster ions containing iron and cobalt was studied in the gas phase by using Fourier transform mass spectrometry (FTMS). The dimers Fe_2^+, $CoFe^+$, and Co_2^+ react rapidly with ethylene oxide by sequentially abstracting two oxygen atoms, while the trimers $FeCo_2$ and Co_3^+ abstract up to three oxygen atoms from ethylene oxide. The dimers and trimers also react with dioxygen. In addition, the bimetallic carbonyl cations $Fe_2(CO)_4^+$, $CoFe(CO)_5^+$, and $Co(CO)_3^+$ react rapidly with dioxygen by displacing all the carbonyls forming $M'MO_2^+$ exclusively. The trimetallic carbonyl cations $FeCo_2(CO)_8^+$ and $Co_3(CO)_8^+$ react rapidly with dioxygen by displacing up to four carbonyls to generate $M'M_2(O)_2(CO)/sub\ n/^+$ (n = 1-3). These species undergo a subsequent reaction with dioxygen which displaces the remaining carbonyls to generate both $M'M_2O_4^+$ and $M'M_2O_3^+$. The $M'M_2O_4^+$ species subsequently transfers an oxygen atom to dioxygen to generate $M'M_2O_3^+$ and presumably O_3. No fragmentations were observed for collisional activation of the $M'MO^+$, while the $M'MO_2^+$ species yielded M^+ and $M'MO^+$ in low efficiency, the $M'M_2O_3^+$ species yielded M^+ and $M'MO^+$ in very low efficiency, and the $M'MO_2O_4^+$ species yielded $M'M_2O_3^+$. Finally, the observed ion-molecule reactions yield $D^0(M'M^+\text{-}O) > 119$ kcal/mol, 204 kcal/mol $< D^0(M'M^+\text{-}20) <$ 238 kcal/mol, $D^0(M'M_2^+\text{-}O) >$ 85 kcal/mol $D^0(M'M_2O^+\text{-}O) >$85 kcal/mol, $D^0(M'M_2O_2^+\text{-}O) >$ 85 kcal/mol, and $D^0(M'M_2O_3^+\text{-}O) <$ 25.5 kcal/mol. 49 references, 1 table.

11847 Thermochemistry of solvation of NO_2p and $C_6H_5NO_2^-$ by polar molecules in the vapor phase. Comparison with Cl^- and variation with ligand structure. Sieck, L.W. (National Bureau of Standards, Gaithersburg, MD). *Journal of Physical Chemistry;* **89**: No. 25, 5552-5556(5 Dec 1985).

The stabilities of NO_2^- x HR and $C_6H_5NO_2^-$ x HR associations ions, where HR is a dipolar protic or aprotic organic molecule, have been investigated by the technique of pulsed electron beam high-pressure mass spectrometry. For comparison, analogous measurements were also made with Cl^-. Equilibrium constants were determined as a function of temperature in order to define ΔH^0 and ΔS^0 values for solvation. The binding energies vary as $NO_2^- = Cl^- > C_6H_5NO_2^-$ for ligands with -OH sites. On the average, the bond strength in $C_6H_5NO_2^-$ x HR complexes is found to be ~ 2.1 $kcal/mol^{-1}$ lower than for those incorporating Cl^-. For classes of ligands in which the nature of the bonding is expected to be similar, the binding energies increase with increasing acid strength of the ligand. With the exception of the aprotic ligands, CH_3NO_2 and CH_3CN, the association entropies for cluster ions incorporating NO_2^- and $C_6H_5NO_2^-$ are significantly higher than those having C_3^- as the core ion, and the values for complexation of a common ligand by NO_2^- and $C_6H_5NO_2^-$ are essentially identical. Probable structures for $C_6H_5NO_2^-$ x HR ions are presented and discussed. 19 references 5 figures, 2 tables.

11848 Why the energetic minimum aluminum vinylidene is not observed in low-temperature aluminum + acetylene reactions. Scheiner, A.C.; Schaefer, H.F. III. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **107**: 4451-4453(1985). Contract AC03-76SF00098.

Ab initio molecular electronic structure theory has been used to investigate the Al + C_2H_2 potential energy surface. Particular emphasis was placed on resolving the apparent conflict between theory and experiment by examining the barrier to rearrangement between cis-AlHCCH (observed by ESR at 4 K) and $AlCCH_2$ (theoretically predicted global energy minimum). Analytic self-consistent-field (SCF) gradients were employed with a double-zeta basis set to locate and characterize stationary points on the energy surface. Single point CI calculations using a double-zeta + polarization basis set have been carried out at the DZ-SCF stationary points. A DZP-CI barrier of 39.1 kcal for the cis-AlHCCH → $AlCCH_2$ isomerization has been found. Such a barrier is clearly prohibitive to this isomerization under the experimental conditions of 4 K. By comparing this isomerization to the bare HCCH → CCH_2 isomerization, the effect of the aluminum atom has been found to be significant. 13 references, 1 figure, 1 table.

11849 Alloxan-electrostatic properties of an unusual structure from x-ray and neutron diffraction. Swaminathan, S.; Craven B.M.; McMullan, R.K. (Univ. of Pittsburgh, PA). *Acta Crystallographica, Section B: Structural Crystallography and Crystal Chemistry;* **B41**: 113-122(1985).

The crystal structure of alloxane has been determined from neutron diffraction data at 123 K. The crystal data are presented for the tetragonal form. Alloxan was found to have an unusually high crystal density (1.93 g/cm^{-3} 295 K) apparently due to short intermolecular O=C...O distances (2.73 A at 123 K). There appeared to be no H-bonding except for a weak bifurcated interaction with H...O distances (2.32, 2.35 A at 123 K). Bond lengths and angles from neutron diffraction have e.s.d.'s less than 0.002 A and 0.01 indicating that the effect of conjugation in alloxan are small. With fixed values for all nuclear positional and thermal parameters as determined by neutron diffraction, the x-ray data were used to determined the charge-density distribution assuming Stewart's rigid

pseudoatom model. The resulting electron population parameters were also used to map the electrostatic potential for an isolated molecule and for a selected group of molecules removed from the lattice. Electrostatic properties show the bifurcated H-bond to be weakly attractive. In the carbonyl groups, electron density at the C atom is depleted from both sides of the molecular plane, thus deshielding the atomic nucleus. Although the shortest intermolecular C...O distances are formed with O atoms carrying a small negative charge, -0.11 (3)e, these interactions are weak. It appears that the van der Walls radius for carbonyl C atoms should be smaller than for aromatic C atoms by at least 0.2 A. 46 references, 8 figures, 5 tables.

11850 **Studies of negative ion formation in fluroethers and fluorosulfides using low-energy (≦10 eV) electron beam and electron swarm techniques.** Spyrou, S.M.; Hunter, S.R.; Christophorou, L.G. (Oak Ridge National Lab., TN). *Journal of Chemical Physics;* **81**: No. 10, 4481-4493(15 Nov 1984). Contract AC05-84OR21400.

The attachment of low-energy (≦10 eV) electrons to four fluoroethers (CF_3OCF_3, CF_3OCF_2H, CF_2HOCF_2H and CF_3OCH_3) and two fluorosulfides (CF_3SCF_3 and CF_3SCH_3) has been studied using a time-of-flight mass spectrometer (TOFMS) and a high pressure electron swarm technique. All six molecules were found to attach electrons dissociatively. The types and relative intensities of the fragment anions depend strongly on the number and relative positions of the F atoms in the molecule and on the presence of O or S atoms in the molecule. The fluorosulfides attach lower energy electrons than do the fluoroethers. The magnitude of the total electron attachment rate constants increases with increasing number of F atoms in the molecule. The observed negative ions (in decreasing order of intensity) and the positions of peak intensities (given in parentheses in eV) are: F^-(5.3) and CF_3O^-(4.8) from CF_3OCF_3; CF_3O^-(3.7), F^-(5.7), HF_2^-(6.1), CFO^-(5.9), and CF_3^-(6.7) from CF_3OCF_2H; CF_3O^-(3.0), HF_2^-(4.7), F√(5.0), and CFO^-(4.9) from CF_2HOCF_2H; F^-(6.7) from CF_3OCH_3; CF_3S^-(0.6) and F^-(3.8) from CF_3SCF_3; CF_3S^-(~0.0) from CF_3SCH_3. Energetic considerations were employed to identify possible fragmentation mechanisms of the negative ion states (NISs) leading to the production of the observed fragment negative ions and to deduce values for the electron affinities of the radicals CF_3O and CF_3S. CNDO/2 and MNDO molecular orbital calculations were performed on all six molecules investigated in an effort to rationalize the types, relative intensities, and positions of the maxima in the cross sections of the observed anions.

11851 **Excited-state dynamics of the intramolecular proton transfer of 3-hydroxyflavone in the absence of external hydrogen-bonding interactions.** McMorrow, D.; Dzugan, T.P.; Aartsma, T.J. (Florida State Univ., Tallahassee). *Chemical Physics Letters;* **103**: No. 6, 492-496(20 Jan 1984). Contract AS05-78EV05855.

A single exponential risetime is observed for the tautomer fluorescence of 3-hydroxyflavone in the absence of hydrogen-bonding impurities in the temperature range of 298-77 K. The observed risetime in hydrocarbon solvents is less than 8 ps at 298 K, while at 77 K it is 37 +/- 6 ps. The discrepancy with other reports is attributed to hydrogen-bonding solvent impurities which inhibit the intramolecular proton transfer process.

11852 **Differentiation of polycyclic aromatic hydrocarbons using electron capture negative chemical ionization.** Buchanan, M.V.; Olerich, G. (Oak Ridge National Lab., TN). *Organic Mass Spectrometry;* **19**: No. 10, 486-489(1984). Contract W-7405-ENG-26.

A number of isomeric polycyclic aromatic hydrocarbons may be distinguished using electron capture negative chemical ionization when methane is used as a buffer gas, including benzo[a]pyrene and benzo[e]pyrene. The ionization behavior of these compounds may be predicted on the basis of their electron affinities, allowing compounds to be distinguished without the use of standards.

11853 **Kinetics of demetallation of manganese(II) porphyrins in aqueous solutions.** Morehouse, K.M.; Neta, P. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **88**: No. 14, 3118-3120(1984).

Radiolytic reduction of Mn/sup III/TPPS, Mn/sup III/TMPyP, and Mn/sup III/TPyP in acid solutions produces the manganese (II) porphyrins which then undergo demetallation. The rates of demetallation were monitored by kinetic spectrophotometry at various $[H^+]$. The results show that Mn/sup II/TPPS/ hydrolyzes to H_4TPPS^{2+} in a process whose rate is dependent on $[H^+]$ at 20-60 mM, with $k \sim 1 \times 10^6\ M^{-1}s^{-1}$, but dependent on $[H^+]^2$ at $[H^+] <$ 10 mM, with $K \sim 4 \times 10^7\ M^{-2}s^{-1}$. The two pyridyl porphyrins demetallate much more slowly, with rate constants at 0.1-1.0 M H^+ dependent on $[H^+]^2$, with $k \sim 5 \times 10^4\ M^{-2}s^{-1}$.

11854 **Triiodide on formation equilibrium and activity coefficients in aqueous solution.** Palmer, D.A.; Ramette, R.W.; Mesmer, R.E. (Oak Ridge National Lab., TN). *Journal of Solution Chemistry;* **13**: No. 9, 673-683(1984). Contract W-7405-ENG-26.

The equilibrium quotient for the formation of triiodide was studied as a function of temperature, 3.8-209.0°C, and ionic strength, 0.02-6.61. The best-fit value for the molal equilibrium constant at 25°C is 698 +/- 10 and the corresponding partial molal enthalpy, entropy, and heat capacity of formation are: ΔH° = -17.0 +/- 0.6 kJ-mol^{-1}, ΔS° = -0.6 +/- 0,3 J-K^{-1}-mol^{-1}, and ΔD/sub p/ $^\circ$ = -21 +/- 8 J-K^{-1}-mol^{-1}. Activity coefficients of iodine were determined as a function of ionic strength ($NaClO_4$) at 25°C and conclusions are drawn as to the corresponding ionic strength dependence of the triiodide anion.

11855 **Surface diffusion of chemisorbed sulfur on nickel(111).** Wood, B.J.; Ablow, C.M.; Wise, H. (SRI International, Menlo Park, CA). *Applications of Surface Science;* **18**: 429-436(1984). Contract AM03-76SF00115.

The diffusion coefficient of sulfur adatoms ion Ni(111) was determined at 650 K by measuring with Auger electron spectroscopy the diffusional radial spreading from a central source. The results were analyzed in terms of a surface-coverage dependent diffusion model and good agreement was observed at fractional saturation coverage theta < 0.7. At high surface coverage significant deviation of the data from the theoretical model results from reconstruction of the substrate. 16 references, 4 figures, 1 table.

11856 **C=O stretching vibration of CO on Ni(100) by infrared emission spectroscopy.** Tobin, R.G.; Chiang, S.; Thiel, P.A.; Richards, P.L. (Univ. of California, Berkeley). *Surface Science;* **140**: 393-399(1984). Contract AC03-76SF00098.

Infrared emission spectroscopy has been used to study the C=O stretching vibration of CO on Ni(100) at 310 K. In contrast to previous electron energy loss and infrared measurements, no bridge-bonded CO is observed at any coverage blow theta = 0.5. Variations in the lineshape with exposure suggest the presence of c(2 X 2) islands event at low coverage, though low energy electron diffraction shows no sign of such ordering. 9 references, 2 figures.

11857 **Electron transfer reactions in condensed phases.** Newton, M.D.; Sutin, N. (Brookhaven National Lab., Upton, NY). *Annual Review of Physical Chemistry;* **35**: 437-480(1984).

Despite the multitude of formalisms, there is general agreement that the crux of the electron transfer problem is the change in equilibrium nuclear configurations that occurs when a molecule or ion gains or loses an electron. In recent developments attention has been focused on the dynamics of these nuclear configuration changes, and, in addition, on the electronic factors, determining the electron transfer rate. In parallel with these theoretical developments there have been a large number of experimental studies. These studies have not only elucidated the factors determining electron transfer rates, but have in many cases directly tested the theories and suggested modifications to the theories where appropriate. It is impossible in an article such as this to cover the entire area of electron transfer reactions. Instead the authors shall concentrate on those aspects of the problem in which they are particularly interested. Steady-state schemes for the diffusion, activation, and electron transfer steps in bimolecular reactions are discussed first. This is followed by a description in terms of Born-Oppenheimer states and surfaces and a discussion of the classical, semiclassical, and quantum mechanical formalisms. Recent experimental studies bearing on the

questions raised are presented in the final section. Throughout the discussion to localized or trapped systems is restricted, specifically to systems in which the electronic interaction of the initial and final states is sufficiently small so that the electron transfer can be described in terms of the electronic properties of the unperturbed reactants and products.

11858 Cross-polarization and magic angle sample spinning NMR of model organic compounds with extremely long ^1H T_1's. Murray, D.P.; Dechter, J.J.; Kispert, L.D. (Univ. of Alabama, University). *Journal of Polymer Science, Polymer Letters Edition;* **22**: 519-522(1984).

The ^1H spin-lattice relaxation time of poly(-phenylene) as well as p-sexiphenyl, p-quarterphenyl, p-terphenyl, and biphenyl has been determined. The previously reported difficulty in obtaining cross-polymerization, magic angle spinning (CPMAS) NMR spectra for the shorter oligomers has been verified. It has also been established that relative intensity for the oligomers should be a reliable method for probing the structures of the parent polymer. It has also been noted that the ^1H relaxation time of these phenylene oligomers can be extraordinarily long. These phenylene oligomers studied here have been shown to be further examples of systems lacking a methyl or other group capable of rapid internal rotation and lacking significant amorphous material. 19 references, 1 figure, 1 table.

11859 Laser Raman spectroscopic study of anodic corrosion films on silver and copper. Melendres, C.A.; Xu, S.; Tani, B. (Argonne National Lab., IL). *Journal of Electroanalytical Chemistry;* **162**: 343-349(1984).

Raman spectroscopy has been applied to the study of anodic corrosion processes of silver and copper films in sulfate solutions. The in-situ bands at 450, 608, and 960 cm^{-1} observed in the Raman spectra of Ag anodized in 0.05 M H_2SO_4 correlate well with the bands observed for standard Ag_2SO_4, although the bands are somewhat broader. This is interpreted as an indication of some structural difference between the electrochemically produced Ag_2SO_4 and the standard. X-ray diffraction studies of the film further substantiated the presence of Ag_2SO_4. In-situ and ex-situ Raman spectra and x-ray diffraction of the film material formed by the anodic oxidation of Cu in H_2SO_4 and Na_2SO_4 solutions indicated that the film material was Cu_2O. 15 references, 5 figures, 1 table.

11860 Solvent selectivity studies using isomers of polystyrene. Men, L.C.; Na, H.; Rogers, L.B. (Univ. of Georgia, Athens). *Journal of Chromatography;* **314**: 55-63(1984). Contract AS09-76ER00854.

The order of elution of isomeric trimers of polystyrene has been found to be independent of the dominant solvent-solute interaction as indicated by the location of the solvent in a Snyder triangle. The pure solvents were nitromethane, propylene carbonate, N-methylformamide, acetonitrile, the mixtures were trifluoroethanol with chloroform, methylene chloride and trichlorotrifluoroethane and also one of 2-methoxyethanol with water. Likewise, mixtures of acetonitrile with solvents near each of the corners of that triangle (chloroform, methylene chloride, and trifluoroethanol did not change the order of isomer elution). Substitution of trifluoroethanol for ethanol in mixtures with chloroform, methylene chloride, or trichlorotrifluoroethane led to improved isomer fractionations. 3 references, 5 figures, 2 tables.

11861 High-performance liquid chromatographic study of the chlorophyll allomerization reaction. Schaber, P.M.; Hunt, J.E.; Fries, R.; Katz, J.J. (Canisius College, Buffalo, NY). *Journal of Chromatography;* **316**: 25-41(1984). Contract W-31-109-ENG-38.

The allomerization of chlorophyll has been investigated by reversed-phase HPLC. Four major product peaks (two sets of doublets) are observed in the HPLC chromatogram. These are shown to be pairs of stereoisomers of two major components. Similar results have been obtained from the allomerization of fully deuterated chlorophyall a. Attempts to characterize the reaction products and to delineate the reaction mechanism were initially studied by the oxidation of chlorophyll in the absence of extraneous nucleophiles. The structure of the reaction products of chlorophyll allomerization were conclusively identified as 10-hydroxychlorophyll and the 10-methoxylactone by co-chromatography, NMR, and ^{252}Cf plasma-desorption mass spectroscopy. Exploratory studies on the allomerization products of bacteriochlorophyll have also been carried out. 28 references, 7 figures, 4 tables.

11862 Structure of iodo(methylene)tetrakis(trimethylphosphine)tungsten trifluoromethane-sulfonate, $[WI(CH_2)\{P(CH_3)_3\}_4][CF_3SO_3]$. Schultz, A.J.; Williams, J.M.; Schrock, R.R.; Holmes, S.J. (Argonne National Lab., IL). *Acta Crystallographica, Section C: Crystal Structure Communications;* **40**: 590-592(1984). Contract W-31-109-ENG-38.

The crystal parameters are reported for the rhombohedral (hexagonal) titled compound. The coordination geometry about the tungsten is pseudooctahedral with the methylene and iodo ligands in a trans configuration. The W-C(1) distance of 1.83(2) A indicates a W-C bond order of between 2 and 3. Other bond distances are W-I = 2.881(2) A and W-P = 2.519(4) and 2.057(4) A. 13 references, 2 figures, 2 tables.

11863 Ab initio molecular orbital calculations of the first two adiabatic ionizations of the water dimer. Curtiss, L.A. (Argonne National Lab., IL). *Chemical Physics Letters;* **96**: No. 4, 442-446(15 Apr 1983).

Ab initio molecular orbital methods have been used to study the first two adiabatic ionizations of the water dimer. Both ionizations cause considerable geometrical rearrangements in the water dimer structure. Good agreement is found with experiment on the difference between the vertical and adiabatic energies for the first ionization. 14 references, 1 figure, 3 tables.

11864 Dialkyl bis[bis(trimthylsilyl)amido] Group 4A metal complexes. Preparation of bridging carbene complexes by γ elimination of alkane. Crystal structure of $\{ZrCHSi(Me)_2NSiMe_3[N(SiMe_3)_2]\}_2$. Planalp, R.P.; Andersen, R.A.; Zalkin, A. (Univ. of California, Berkeley). *Organometallics;* **2**: No. 1, 16-20(1983). Contract AC03-76SF00098.

The dialkyls of zirconium of the type $R_2Zr[N(SiMe_3)_2]_2$, where R is Me, ET, or CH_2SiMe_3, thermally decompose (60°C (10^{-2}mm)) by elimination of alkane (MeH, EtH, or Me_4Si, respectively) to yield the bridging carbene compounds. The 1:1 complex with pyridine is described. The related hafnium dialkyls decomposed in a related manner though in this case the decomposition product can only be characterized as its pyridine complex. The NMR spectra of the pyridine complexes of zirconium and hafnium are similar. In contrast, the corresponding titanium compound is thermally stable to 190°C. The titanium carbene may be prepared by sodium amalgam reduction of $Cl_2Ti[N(SiMe_3)_2]_2$. The crystal structure of the bridging carbene compound of zirconium was determined by single-crystal x-ray crystallography. The crystals were found to be orhtorhombic of space group Pbca, and the cell consists of three, fused planar, four-membered rings giving the molecule a tub configuration. The Zr-C bond distances are 2.16 A, and the Zr-N distances are 2.04 to 2.09 A. 20 references, 4 tables.

11865 Chemical and tracer diffusion in nonstoichiometric binary oxides. McKee, R.A. (Oak Ridge National Lab., TN). *Radiation Effects;* **75**: 145-150(1983). Contract W-7405-ENG-26.

A recently developed theory for diffusion in nonstoichiometric crystals is used to review data that are available for chemical and tracer diffusion in the cubic iron oxide Fe/sub 1-delta/O. The theory describes the chemical diffusion coefficient, D, by a very simple relationship involving the tracer diffusion coefficient. D, f, the stoichiometry-dependent correlation factor for iron ions, δ, the measure of nonstoichiometry in Fe/sub 1-delta/O, and a_o, the activity of oxygen in the oxide crystal. The relationship provides for a comprehensive treatment of the influence of nonstoichiometry on the rate of iron oxidation and iron diffusion in this cubic oxide. 17 references, 2 figures.

11666 **Infrared and Raman spectra of crystalline para-bromoaniline at low temperatures.** Jaiswal, R.M.P.; Katon, J.E.; Tripathi, G.N.R. (Miami Univ., Oxford, OH). *Spectrochimica Acta, Part A: Molecular Spectroscopy;* **39A**: No. 3, 275-281(1983).

The polarization characteristics of the ir absorption bands of oriented p-bromoaniline crystal films have been studied at low temperatures. Raman spectra of this compound in solution and in the polycrystalline state have been recorded as an aid to the vibrational assignment of the crystal bands. The vibrational spectra are interpreted to deduce the crystal factor group (D/sub 2h/) and the molecular site symmetry (C/sub s/). The observed factor group splittings and dichroic ratios suggest the crystal unit cell of p-bromoaniline to be isostructural with the of p-chloroaniline. 16 references, 5 figures, 1 table.

11667 **Relative gas-phase acidities from triple quadrupole mass spectrometers.** Wright, L.G.; McLuckey, S.A.; Cooks, R.G.; Wood, K.V. (Purdue Univ., West Lafayette, IN). *International Journal of Mass Spectrometry and Ion Physics;* **42**: 115-124(1982). Contract FG22-81PC40780.

Chemical ionization of mixtures of aliphatic acids yields proton-bound dicarboxylate anions which are mass-selected and subjected to collision-induced dissociation (CID) at 5-30 eV. The branching ratio for formation of the principal fragments, $R_1CO_2^-$ and $R_2CO_2^-$, is used to follow internal energy deposition in the proton-bound anion as a function of collision energy and target pressure. Increased energy deposition is observed with increases in pressure and in translational energy, although the branching ratio also shows effects attributed to severe discrimination against the lighter fragment at pressures exceeding the limit for single collisions. These discrimination effects are most pronounced at low collision energy and are not observed (for argon target gas) at the higher energies. The relative abundances of the carboxylate fragments correlate with their relative proton affinities. In this, and in the fact that quantitative assignments of relative proton affinities are possible, the triple quadrupole methodology gives results which parallel those obtained using keV beams in sector mass spectrometers. Detailed similarities between the low- and high-energy studies include the anomalous behavior of formic acid in both and quantitative agreement in measured gas-phase acidities for valeric and hexanoic acid.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 11422, 11611, 11669, 11670, 11671, 11737, 11793

11668 **(DOE/ER/45106—1) Electrode studies in molten salts: Final report for the period June 1, 1984-May 31, 1986.** Devereux, O.F. (Connecticut Univ., Storrs (USA)). 15 Oct 1986. Contract FG02-84ER45106. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003573.

The work performed under this contract consisted primarily of a study of the deterioration of refractory oxide films in molten sodium carbonate. Films were prepared by anodic oxidation of NiAl in sodium carbonate at 1000°C. The impedance of the anodized NiAl substrates was found to follow models consisting of resistive and capacitive elements, combined with Warburg or diffusive elements. No evidence, derived from impedance behavior or otherwise, was found of refractory oxide dissolution or "fluxing" as a result of immersion in the molten carbonate. Rather, the impedance behavior of the immersed film-covered substrates was consistant with a continued growth of the oxide, whether under cathodic, zero or anodic polarization, interrupted by apparent spalling of the oxide due, presumably, to growth stresses. A secondary task within this program involved an exploratory examination of the behavior of chromium electrodes in molten sodium polysulfide at ~375°C. The anodic behavior of this system was characterized by the formation of a "blocking" film of elemental sulfur.

11669 **(PNL-SA—14040) Surface analysis and electrochemical studies of sulfur enhanced corrosion of nickel.** Baer, D.R.; Danielson, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 16p. (CONF-861019—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002472.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

A combined surface analysis and electrochemical study of sulfur implanted nickel has examined the lifetime of sulfur on the surface and the mobility of sulfur on the surface and in an acid solution. XPS and AES have been used to examine the chemistry, location and amount of sulfur on the surface and in films formed on the implanted nickel in a 0.5 normal nitric acid solution at various electrochemical potentials. Specimens were prepared in a low oxygen partial pressure glove box and transferred to the spectrometer in an anaerobic transfer vessel. Although most sulfur is removed from the implanted nickel during rapid dissolution, a submonolayer of sulfur remains on the surface in "sulfide" form in the active region. Upon exposure to higher oxidizing potentials, some of the sulfur is oxidized and both sulfate and sulfide are found in the film. Recycling the film back to the active region removed some of the oxidized sulfur, but much of the sulfur remains on the surface. Sulfur transfers through the solution to nearby materials where it appears on the surface in both "sulfide" and sulfate states. Current studies suggest only a very slow oxidation of sulfur on the surface or in solution. 13 refs., 4 figs.

11670 **Anodic dissolution of iron phthalocyanine film electrodes.** Melendres, C.A. Xu, S.Q. (Argonne National Lab., IL). *Journal of the Electrochemical Society;* **131**: No. 2, 466-467(1984).

Phthalocyanine electrodes are finding use for O_2 reduction, and results have been previously reported showing the existence of an anodic wave at about 0.6 V vs H/Hg_2SO_4 in the cyclic voltammorgram of iron phthalocyanine (FePc) film electrodes. Results of investigations by rotating-disc electrode and Raman spectroscopy indicating that this wave is associated with the anodic dissolution of the FePc films are presented in this paper. The Raman spectroscopic examination of the film in-situ indicated that the FePc was dissolving; because at 0.8 V, the entire band due to FePc disappears. The solution appearance did not indicate the presence of hydrated Fe ions, so it is assumed that the FePc film is irreversibly anodically dissolved and passes into solution either as a solvated cation or other soluble entity. 6 references, 3 figures.

4005 Photochemistry

REFER ALSO TO CITATION(S) 11825, 11830

11671 **(DOE/ER/13102—4) Photoexcited charge pair escape and recombination: Final report for period July 1, 1983-July 31, 1986.** Braun, C.L. (Dartmouth Coll., Hanover, NH (USA). Dept. of Chemistry). 12 Dec 1986. Contract AC02-83ER13102. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003777.

We have studied the escape and recombination of charge pairs produced by photo-excitation of organic molecules. In the work which is furthest advanced, we used a novel picosecond pulse-probe technique to time-resolve the recombination dynamics of geminate charge pairs produced in liquid hexane. The technique involves probing a uv-produced population of charge pairs with an ir pulse which can be delayed with respect to the uv pulse. The ir pulse stimulates dissociation of the charge pairs and this increased dissociation results in an increased electrical conductivity of the liquid sample. The magnitude of the ir stimulated conductivity as a function of the time delay of the ir pulse monitors the decay with time of the geminate pair population. This technique is very sensitive and allows measurement of the charge pair recombination kinetics for samples of 10-20 mm^3 volume containing only 10^{-9} mol/L of geminate pairs. The conductivity measurement is not time resolved and makes use of a simple electrometer which effectively counts the electrons which escape the coulombic grasp of their sibling cations. A second goal of the original proposal was to under-

stand the mechanism of charge pair escape in electronically-excited, electron donor-acceptor (EDA) materials. A theoretical study of the electric field assisted, thermal-dissociation of charge-transfer (CT) states in crystals or polymers has been published. Experimental progress in this area has been minimal, but a few results are described. 17 refs., 9 figs.

11872 **(LBL—22356) Chemical Biodynamics Division: Annual report, October 1, 1985-September 30, 1986.** (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 65p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87003637.

The research in the Laboratory of Chemical Biodynamics is almost entirely fundamental research. The biological research component is strongly dominated by a long term interest in two main themes which make up our Structural Biology Program. The first interest has to do with understanding the molecular dynamics of photosynthesis. The Laboratory's investigators are studying the various components that make up the photosynthetic reaction center complexes in many different organisms. This work not only involves understanding the kinetics of energy transfer and storage in plants, but also includes studies to work out how photosynthetic cells regulate the expression of genes encoding the photosynthetic apparatus. The second biological theme is a series of investigations into the relationship between structure and function in nucleic acids. Our basic mission in this program is to couple our chemical and biophysical expertise to understand how not only the primary structure of nucleic acids, but also higher levels of structure including interactions with proteins and other nucleic acids regulate the functional activity of genes. In the chemical sciences work in the Laboratory, our investigators are increasing our understanding of the fundamental chemistry of electronically excited molecules, a critical dimension of every photosynthetic energy storage process. We are developing approaches not only toward the utilization of sophisticated chemistry to store photon energy, but also to develop systems that can emulate the photosynthetic apparatus in the trapping and transfer of photosynthetic energy.

11873 **Electron paramagnetic resonance and optical evidence for two distinct porphyrin triplet states in linked porphyrin-quinone molecules.** McIntosh, A.R.; Bolton, J.R.; Connolly, J.S.; Marsh, K.L.; Cook, D.R.; Ho, T.F.; Weedon, A.C. (Univ. of Western Ontario, London). *Journal of Physical Chemistry;* **90**: No. 22, 5640-5646(23 Oct 1986).

The authors have carried out a spectroscopic and photophysical study of the triplet states of a series of meso-tetratolylporphyrins to which certain molecular moieties have been covalently attached via diamide linkages, the two amides being separated by n methylene groups (n = 2-4). The attached end groups include methyl-p-benzoquinone, the corresponding hydroquinone, and dimethoxybenzene. At low temperatures (~90 K) in frozen solvent matrices, the authors have found electron paramagnetic resonance (EPR) spectral evidence of two triplet states with different zero-field splitting parameters. The authors attribute this behavior to conformational heterogeneity in the linked molecules. The data are best interpreted as arising from perturbed (i.e., complexed) or normal (i.e., extended) porphyrin triplets. This is consistent with the previous interpretations of the absorption and fluorescence properties of these molecules. The EPR intensities also exhibit spectra photoselection on excitation in red-shifted and broadened porphyrin Soret band. Over the temperature range 80-300 K, laser flash photolysis experiments with time resolved detection of optical absorption show decay kinetics for these same linked porphyrin molecules which confirm the existence of two porphyrin triplets with different lifetimes in the complexed and extended conformers, respectively. Kinetic analysis of the transient absorbance profiles suggest that interconversion of the two molecular forms is slow on the time scale of a few hundred microseconds, even at room temperature.

11874 **Picosecond pump-probe experiments on surface-adsorbed dyes: ground-state recovery of rhodamine 640 on ZnO and fused silica.** Anfinrud, P.A.; Causgrove, T.P.; Struve, W.S. (Iowa State Univ., Ames). *Journal of Physical Chemistry;* **90**: No. 22, 5887-5891(23 Oct 1986). Contract W-7405-ENG-82.

From 8. Department of Energy Solar Photochemistry research conference; Lake Geneva, WI, USA (11-14 Jun 1984).

Ground-state recovery dynamics were monitored for rhodamine 740 adsorbed with as little as ~0.1 monolayer coverage on ZnO and fused silica, using 590-nm 12-ps full width at half-maximum pulses from a synchronously pumped dye laser. The recovery dynamics are coverage-dependent on silica and are dominated by excitation trapping by due aggregates whose number density increases with dye coverage. The ground-state recovery in ultrafast and essentially independent of coverage on ZnO; this provides strong evidence for efficient dye → surface nonradiative excitation decay.

11875 **Rate constant for the $O(^3P) + CH_4 \rightarrow OH + CH_3$ reaction obtained by the flash photolysis-shock tube technique over the temperature range $763 \leqq T \leqq 1755$ K.** Sutherland, J.W.; Michael, J.V.; Klemm, R.B. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **90**: No. 22, 5941-5945(23 Oct 1986). Contract AC02-76CH00016.

The rate constant for the reaction of $O(^3P)$ with methane was measured over the temperature range $763 \leqq T \leqq 1755$ K by the flash photolysis-shock tube technique. The results, k (cm^3 molecule $^{-1}s^{-1}$) = 9.2 x 10^{-19}T/sup 2.40/ exp(-2838/T), agree with those of previous workers who employed different experimental methods and thus endorses the flash photolysis-shock tube technique as an important method for measuring rate constants in the temperature range ~ 800 K $\leqq T \leqq$ 2000 K. A recommended rate expression for the reaction of $O(^3P)$ with CH_4, k(cm^3 molecule$^{-1}s^{-1}$) = 1.15 x 10^{-18}T/sup 1.56/ exp(-4270/T) over the temperature range 400 K $\leqq T \leqq$ 2250 K, was derived from an evaluation of the combined results of the present study and those of selected previous investigations.

11876 **Laser flash photolysis study of 2,6-dimethyl-3,5-diphenyl-4-pyrone and related chromones. Evidence for triplet state structural relaxation from quenching behaviors.** Bhattacharyya, K.; Ramaiah, D.; Das, P.K.; George, M.V. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **90**: No. 22, 5984-5989(23 Oct 1986).

The 308- or 337.1-nm laser excitation of 2,6-dimethyl-3,5-diphenyl-4-pyrone (1), 2-phenylchromone (2), and 2,3-diphenylchromone (3) results in the formation of short-lived triplets (tau$_0$/sup T/ = 1-5 μs, λ/sub max//sup T/ = 330-365 nm) in high yields (0.5-1.0 in benzene). From phosphorescence spectra at 77 K, the spectroscopic triplet energies of these aromatic enones are estimated at 69, 62, and 67 kcal mol^{-1}, respectively. However, in fluid solutions at room temperature, the triplets are poorly quenched by 1-methylnaphthalene (E/sub T/ = 59.6 kcal mol^{-1}), dienes (E/sub T/ ≈ 59 kcal mol^{-1}), and ferrocene (E/sub T/ ≈ 40 kcal mol^{-1}). In spite of the apparent exothermicity, the energy-transfer processes are inefficient; this suggests geometric distortion in these triplets, very probably in the form of partial twisting about the ene double bonds, causing a lowering of vertical energy (at relaxed geometry) by ~30 kcal mol^{-1}. The quenching behavior of the triplet of 2, however, is normal, the rate constants for quenching by the above-mentioned quenchers being in the limit of diffusion control. A major reason for the excited-state torsional distortion in 1 and 3 appears to be the steric interaction between adjacent substituents (phenyl and methyl) on the carbon atoms of the ene double bond.

11877 **Emission spectroscopy of photodissociating molecules: a collinear model for CH_3I and CD_3I.** Sundberg, R.L.; Imre, D.; Hale, M.O.; Kinsey, J.L.; Coalson, R.D. (Massachusetts Institute of Technology, Cambridge). *Journal of Physical Chemistry;* **90**: No. 21, 5001-5009(9 Oct 1986).

The photodissociation of CH_3I and CD_3I is treated in a pseudolinear triatomic model involving the electronic ground state and a single excited electronic state. Potential energy surfaces were obtained for these two electronic states which agree with experimental data on the absorption spectrum, the Raman or emission spectrum, and the CH_3 or CD_3 final product-state distribution. The eigenvalues and eigenfunctions of the ground electronic potential are calculated and agree to within 1% of experimentally measured values. A Fermi resonance between the C-I stretch and CD_3 umbrella modes in CD_3I causes a serious perturbation in the shape of

the vibrational wave functions. The excited potential energy surface is fit to experimental data by using semiclassical wavepacket dynamics techniques to calculate the absorption and emission spectra. Wavepacket trajectories on the excited surface show the nuclear motion of the molecule during dissociation: at short times the motion is mainly extension of the CI bond, and at later times the CH_3/CD_3 fragment relaxes from a tetrahedral to a planar configuration. Allowing the wavepacket to propagate to large times gives the final-state distributions for the CH_3 and CD_3 fragments which are in qualitative agreement with experimental results.

11878 **Infrared photochemistry of oxetanes: mechanism of chemiluminescence.** Farneth, W.E.; Johnson, D.G. (Univ. of Minnesota, Minneapolis). *Journal of the American Chemical Society;* **108**: No. 4, 773-780(19 Feb 1986).

The infrared multiphoton (IRMP) induced photolysis of several oxetanes is examined at low pressures (ca. 100 mtorr) while experimental variables such as laser frequency, laser energy, bath gas, and bath gas pressure are altered. The products of the IRMP induced photolysis of 2-acyl-3-ethoxy-2-methyloxetane, Ox1, are primary biacetyl and ethyl vinyl ether. When the photolysis is run with the collimated beam of a CO_2 laser (1-3 J/cm²) luminescence is observed. The intensity of the luminescence varies with the efficiency of the unimolecular decomposition of the oxetane. On the basis of the spectral distribution and temporal behavior of the luminescence following irradiation of Ox1, the emitter is believed to be vibrationally hot electronically excited biacetyl. Similar experiments with 2,2-dimethyl-3-ethoxyoxetane give a weaker emission apparently due to excited-state acetone. Results are discussed in terms of the reverse of the Paterno-Buchi reaction - a diabatic retrophotocycloaddition. 52 references, 6 figures, 3 tables.

11879 **Laser flash photolysis of chlorobenzene in polar solvents.** Previtali, C.M.; Ebbesen, T.W. (Univ. of Notre Dame, IN). *Journal of Photochemistry;* **30**: 259-267(1985).

The laser flash photolysis of chlorobenzene at 266 nm was studied in methanol (MeOH) and other polar solvents. The triplet states properties in MeOH were determine: phi/sup T/ = 0.7 +/- 0.2; λ/sub max/ = 305 nm; $\epsilon_3\sqrt{}_5$ = 6500 +/- 800 M^{-1} cm^{-1}; tau = 715 +/- 20 ns. In the presence of LiCl a long-lived transient absorption with λ/sub max/ = 350 nm was observed and it was assigned to Cl_2^-. Part of the absorption was formed immediately after the laser pulse and a slow growth was also observed in the following microsecond. This was interpreted as being partly due to a singlet state very fast C-Cl bond homolysis and partly due to a triplet-mediated generation of Cl. Also the characteristic absorption of solvated electrons was found in MeOH. A photo-ionization quantum yield of 0.03 +/- 0.01 was estimated. The triplet lifetime was determined in various solvents and it was found to decrease with increasing dielectric constant. The Photolysis mechanism of chlorobenzene is discussed in terms of a singlet state photosubstituion reaction with the radical cation as an intermediate, and a singlet and triplet homolytic C-Cl bond breakage. 19 references, 3 figures, 1 table.

11880 **Flash photolysis of transient radicals Benzophenone ketyl radical.** Nagarajan, V.; Fessenden, W. (Univ. of Notre Dame, IN). *Chemical Physics Letters;* **112**: No. 3, 207-211(7 Dec 1984).

A number of processes are found to follow excitation of the benzophenone ketyl radical. The lowest excited state of the radical absorbs, fluoresces and reacts with solvent. Rate constants for reaction of this state with cyclohexane and isopropanol are 4 x 10^7 and 7 x 10^8 $M^{-1}s^{-1}$, respectively. The lifetime of 5.1 ns found in a solution containing 1% cyclohexane in acetonitrile at room temperature is longer than that reported previously.

11881 **Variational method for the calculation of dynamic polarizabilities and two-photon transition moments. The dressed molecule approach.** Huo, W.M. (Univ. of Notre Dame, IN). *Journal of Chemical Physics;* **81**: No. 8, 3407-3414(15 Oct 1984).

The solution of the time-dependent Schroedinger equation of the molecule + radiation field system is analyzed. A quantized radiation field is used. The relationship between the oscillatory wave function and the dressed state wave function is established. The oscillatory wave function being the solution if the radiation field is turned at t = 0 and the dressed state being the stationary solution satisfying the boundary condition only if the field is present at t = -∞. In general, the oscillatory wave function can be expressed using a complete set of dressed states. However, in the presence of a nonresonant radiation field, the system is well represented by a single dressed state. Molecular properties such as dynamic polarizabilities and two-photon transition moments can be deduced from the dressed state wave function instead of the oscillatory wave function as in previous methods. Because of its stationary character, the dressed state is more amenable to approximate calculations. A CI method is developed for this purpose. The CI matrix is simple in form and can be readily constructed using existing computer codes. The presents method can also be adapted to calculate other optical properties.

11882 **Time-resolved resonance Raman spectra and decay kinetics of triplet anthracene in fluid media.** Tripathi, G.N.R.; Fisher, M.R. (Univ. of Notre Dame, IN). *Chemical Physics Letters;* **104**: No. 4, 297-302(10 Feb 1984).

Reported here are the time-resolved resonance Raman spectra and decay kinetics of the lowest triplet state of anthracene-h_{10} and anthracene-d_{10} molecules in fluid media at room temperature. The triplet population (≈3 x 10^{-5} M) is observed to decay at microsecond times by triplet-triplet annihilation. Vibrational assignments for the observed Raman bands are proposed.

11883 **Polymeric photosensitizers: effects of intramolecular energy migration on sensitization efficiences.** Urruti, E.H.; Kilp, T. (Univ. of Notre Dame, IN). *Macromolecules;* **17**: No. 1, 50-54(1984).

The occurrence of intramolecular energy migration was found to have no significant effect on the efficiency of ketyl radical formation via hydrogen abstration from cumene by benzophenone (BP) or poly(vinylbenzophenone) (PVBP). Rate constants were found to be 1.1 x 10^6 and 0.81 x 10^6 M^{-1} s^{-1} for the small molecule and the polymer, respectively. The large difference in rate constants, 9.6 x 10^6 and 22.2 x 10^6 M^{-1} s^{-1} for BP and PVBP, respectively, when tetrahydrofuran was used as a quencher is probably attributable to preferential solvation. Conversely, intramolecular energy migration was found to significantly enhance the overall efficiency of triplet energy transfer to 1-methylnaphthalene (MeN). Rate constants for formation of ^{3}MeN were found to be 0.94 x 10^9 and 1.85 x 10^9 M^{-1} s^{-1} for BP and PVBP, respectively. An energy migration coefficient, LAMBDA, of 3.28 x 10^{-5} cm^2 s^{-1} and a frequency of energy migration, omega, of 7.88 x 10^{10} x^{-1} were calculated for PVBP. For a series of copolymers of methyl methacrylate with vinylbenzophenone, values of LAMBDA and omega were strongly dependent on the ketone content of the polymer and decreased sharply at 40 mol % VBP or less.

11884 **Excited state redox properties of phthalocyanines: influence of the axial ligand on the rates of relaxation and electron-transfer quenching of the lowest ^{3}tt/sup */ excited state.** Ferraudi, G.J.; Prasad, D.R. (Univ. of Notre Dame, IN). *Journal of the Chemical Society, Dalton Transactions: Inorganic Chemistry;* 2137-2140(1874).

Laser flash excitations at 640 nm have been used to generate the transient spectra of the lowest-lying $^3\pi\pi$/sup */ state of phthalocyaninatoruthenium(II) complexes. The properties of this excited state such as the properties of the maxima, λ/sub max/ = 500 +/- 30 nm, and lifetimes, t/sub 1/2/ = 70-4500 ns, exhibit a large dependence on the electron-accepting and electron-withdrawing tendencies of the axial ligands. A similar influence was observed upon the rate of electron-transfer quenching of the $^3\pi\pi$/sup */ state. Values between 10^6 and 10^7 dm^3 mol^{-1} s^{-1} for the self-exchange rate constant have been obtained, according to Marcus-Hush theoretical treatments, for [Ru(pc.)LL']$^+$/($^3\pi\pi$/sup */)[Ru(pc)LL'] [L and L' = neutral axial ligands; pc = phthalocyaninate (2-)] and isoelectronic cobalt(III) and rhodium(III) couples. The redox properties of the ground and excited states are correlated with axial ligand-induced perturbations of the electronic structure.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 11853, 11894, 11895

11885 (ZfI-Mitt—109) Report of the Central Institute for Isotope and Radiation Research. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Dec 1985. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780054.

Individual sections of this report are indexed.

11886 Rate Constants for Reactions of Radiation-Produced Transients in Aqueous Solutions of Actinides. Gordon, S.; Sullivan, J.C.; Ross, A.B. (Chemistry Department, Argonne National Laboratory, Argonne, IL 60439). *Journal of Physical and Chemical Reference Data;* **15**: No. 4, 1357-1367(Oct 1986). Contract AC02-76ER00038.

Rate constants have been critically compiled for reactions of ions of the actinides Am, Cf, Cm, Np, Pu, Th, and U, as well as the element Tc, in different oxidation states with various chemical species in aqueous solution. The reactants include products of the radiolysis of water (hydrated electrons, hydrogen atoms, hydroxyl radicals, hydrogen peroxide) and transient species derived from other solutes (e.g., carbonate radical). The data are useful in the estimation of migration properties of actinides, which are relevant to waste management studies.

11887 Electron spin resonance study of organosulfur radicals produced in electron-irradiated aqueous solutions. Spin trapping with nitromethane aci-anion and 2-methyl-2-nitrosopropane. Taniguchi, H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **88**: No. 25, 6245-6250(1984).

Free radicals produced by the reaction of hydroxyl radicals with a number of organosulfur compounds in N_2O-saturated aqueous solutions have been studied by the in situ radiolysis-steady-state ESR method. Organosulfur radicals (RS.) and additional alkyl radicals have been detected indirectly by spin trapping experiments using nitromethane aci-anion ($CH_2{=}NO_2^-$) and 2-methyl-2-nitrosopropane ($(CH_3)_3CN{=}O$) as spin trapping reagents in the in situ radiolysis system. The ESR parameters of the spin adducts RS-$CH_2NO_2^-$. are as follows: a/sup N/ = 23.98-24.29 G, a/sup H/ (CH_2) = 5.70-7.10 G, a/sup H/(-CHS-CH_2^-) = 0.65-0.83 G, and g = 2.00557-2.00566. The inequivalent hyperfine coupling constants of methylene protons adjacent to the nitrogen and the selective line broadening can be attributed to the chiral carbon atom across a sulfur atom from the methylene group or hindered internal rotation around the C-N bond. The ESR parameters of the spin adducts RS-N(O.)C(CH_3)$_3$ are a/sup N/ = 17.91-18.40 G, a/sup H/(-CHS-N<) $\leqq$ 1.36 G, and g = 2.00626-2.00656. The apparent differences in the trapping efficiency of RS from disulfides, thiols, and sulfides are discussed with the above two spin traps.

11888 Kinetics of electron transfer from cobalt(II) porphyrins to various metalloporphyrin pi-radical cations in irradiated carbon tetrachloride solutions. Grodkowski, J.; Chambers, J.H. Jr.; Neta, P. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **88**: No. 22, 5332-5333(1984).

One-electron oxidation of a series of metallotetraphenylporphyrins (M-TPP) was studied by pulse radiolysis in CCl_4 solutions. The resultant pi-radical cations were found to oxidize Co/sup II/ TPP to Co/sup III/TPP with rate constants of the order of 10^8 M^{-1} s^{-1}, much slower than the diffusion-controlled rates despite the high free energies of these reactions. In the presence of pyridine these electron-transfer reactions were much faster (10^7-10^8 M^{-1} s^{-1}), suggesting that pyridine, as an axial ligand, facilitates the electron transfer between metalloporphyrins. 20 references, 1 table.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 11754, 12405

11889 (INIS-BR—545) Preparation of a homogeneous extract of human growth hormone, isohormone B, and its ^{125}I-labelling for utilization in radioligand assays. Santos, A.J. dos. (Sao Paulo Univ. (Brazil)). 1985. 154p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87700413.

Non-destructive polyacrylamide gel electrophoretic (PAGE) tecnique, with direct UV-densitometry, was set up to permit both qualitative and quantitative studies of human growth hormone (hGH) isohormone purification. This tecnique was used on a preparative scale to obtain milligram amounts of the fundamental form of hGH, isohormone B(Ih-B). Reversed electrophoresis was employed to elute the protein band form the gel. Retention of bio-and immunoactivity was demonstrated via two separate experiments. An 'in vivo' bioassay, based on the weight increase of hypophysectomized rats with a 2 x 2 factorial assay design, was used to compare the true somatotrophic activity of an hGH preparation submitted to the purification process with that of a single control preparation. Retention of immunoactivity was confirmed by studying the antibody binding properties of purified and radioiodinated Ih-B and by determination of its absolute immunopotency against a calibrated secondary standard. Radioimmuno assay curves, determined using Ih-B, as a standard and labelled preparation, showed its applicability in setting up assays based on more homogeneous reagents.

11890 (INIS-mf—10519, pp 48) Radionuclide purity of selected radiopharmaceuticals, imported or manufactured by UJV Rez. Silar, J. (Karlova Univ., Prague, Czechoslovakia. Biofyzikalni Ustav). Apr 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700408. (CONF-8605203—Absts.).

From IAA '86: conference on instrumental activation analysis; Klucenice, Czechoslovakia (4 May 1986).

11891 (NUCLEBRAS-CDTN—545) Radioactive decontaminability in coating materials for nuclear installations. Oliveira Melo, M.A.M. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 7p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700445.

The possibility of decontamination of coating materials is estimated by the Test of Radioactive Decontaminability. This test consists in contamination of test specimens with a nuclide solution of Cs-137 and Co-60 and its decontamination with three steps: demineralized water, tensile and nitric acid solutions. The evaluation is carried by means of an empirically compiled classification of decontaminability factor. It is an easy procedure which allows 'a priori' the estimation of coating materials, which will be used in nuclear facilities. Test specimens of epoxy paints, that shall be used in Angra I and Angra II Nuclear Power Plants, have been assessed: 65% of the samples had an excellent result using only water. Hence, so they are really appropriate for places, where the contamination is possible.

11892 (ORNL—6261, pp 96-120) Chemistry of transuranium elements and compounds. May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

Studies are made in this program to enhance our understanding of the role of 5f electrons in chemical bonding. Most of our studies on the macroscopic scale emphasize certain isotopes available from the National Transplutonium Production Program centered at HFIR/TRU - namely, $_{96}^{248}$Cm, $_{97}^{249}$Bk, $_{98}^{249}$Cf, $_{99}^{253}$Es, and $_{99}^{254}$Es. Particular classes of compounds, such as hydrides, chalcogenides, and pnictides are often selected for study on the basis of their utility in bringing out significant chemical differences between the lanthanides and the actinides. High temperature/high pressure experiments on actinide metals and compounds reveal characteristics about the degree of 5f electron localization as a function of atomic number in the series. Magnetic properties of

metals and compounds are investigated using ultra-sensitive methods and hydration numbers of ions in solution are investigated by neutron scattering at HFIR. As a result of a recently renewed multi-laboratory effort involving four national laboratories, experiments are now being formulated to investigate further the chemical properties of elements 101 to 105 on a "one-atom-at-a-time" basis. Since relativistic effects increasingly modify chemical behavior as one proceeds to heavier elements, ideas and calculations from relativistic quantum theory are employed to suggest experiments. Initial chemical methodologies to be applied in this latter work include solvent extraction, ion exchange, electrochemistry, and gas chromatography. Collaborative nuclear studies, primarily with targets of ^{254}Es, also are carried out with other national laboratories in efforts to discover new isotopes of elements 101 to 105 of utility in chemical experiments or to improve the yields of known isotopes of these elements.

11893 (ZfI-Mitt—109, pp 67-125) **Preparation of labelled compounds for tracer investigations in industry.** Otto, R. Dec 1985. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87780054.

In Report of the Central Institute for Isotope and Radiation Research.

Carrying out tracer investigations in large-scale production plants the labelling of the different materials is characterized by some special aspects. Relatively high activities (10^8 - 10^{10} Bq) have to be applied, but in most cases specific activities only amount to 10^6 - 10^8 Bq/g. Frequently the syntheses of the labelled compounds required can be performed without complicated purification procedures because often it isn't necessary to separate inactive impurities or by-products or to evaporate the solvents. But on the other hand even if many experiments are carried out with the aid of nonisotopic tracers in any case labelled compounds of certain physical and chemical properties must be available. Due to the fact, that the commercial offer of labelled compounds is limited, the users have to prepare a number of special labelled compounds in their laboratories. Therefore in the report the preparation of corresponding ^{24}Na-, ^{64}Cu-, ^{77}Ge-, ^{82}Br-, /sup 99m/Tc-, /sup 113m/In-, ^{131}I-, ^{133}I-, ^{140}La- and ^{198}Au-labelled inorganic and organic compounds is described. The chemical procedures are simple and quick implying the main principles of radiation protection.

11894 **Reaction of T_2 and O_2 gas: a model.** Failor, R.A.; Souers, P.C.; Prussin, S.G. (Lawrence Livermore National Lab., CA). *Journal of Physical Chemistry;* **90**: No. 22, 5974-5984(23 Oct 1986). Contract W-7405-ENG-48.

The kinetics of the homogeneous gas-phase oxidation of tritium ($2T_2 + O_2 \rightarrow 2T_2O$) have been studied by use of a model which accounts explicitly for the radiolysis of the major species and the kinetics of the subsequent reactions of the ionic, excited-state, and neutral species. This report includes a detailed calculation of the radiolysis product distribution due to the tritium β decay with special attention given to oxygen radiolysis. Adjustments were made to hydrogen-based rate constants obtained from the literature to account for kinetic isotope effects. Results from model calculations are given for 10^{-4}-1.0 mol % pure T_2 in pure O_2 at 298 K and 1 atm, from time of mixing to beyond the 1/e conversion time. As the reaction evolves, three different mechanisms control the T_2O production. Each mechanism has a different overall rate expression with a different order with respect to the T_2 concentration. From the predicted mechanisms the importance of the radiolysis products and subsequent ion reaction is evident.

11895 **Track Effects in water radiolysis with high-energy heavy ions.** La Verne, J.A.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **90**: No. 22, 5995-5996(23 Oct 1986).

While the differential yield for HO_2/sup ./ production in the radiolysis of water with 100-200-MeV carbon ions (~ 0.05 molecules/100 eV) is more than twice the yield observed for fast electrons there is little dependence of yield on particle energy or linear energy transfer (LET). This observation suggests that the density of initial events in the spurs produced by highly charged ions is somewhat greater than in electron radiolysis. Detailed examination of the effect of particle charge on track structure is in order.

11896 **Absorption spectrophotometric and X-ray diffraction studies of the trichlorides of berkelium-249 and californium-249.** Peterson, J.R.; Young, J.P.; Ensor, D.D.; Haire, R.G. (Univ. of Tennessee, Knoxville). *Inorganic Chemistry;* **25**: No. 21, 3779-3782(8 Oct 1986). Contract AS05-76ER04447.

Absorption spectrophotometric and X-ray powder diffraction methods have been applied to a study of the trichlorides of ^{249}Bk and ^{249}Cf and their relationship through the β decay of ^{249}Bk. $BkCl_3$ has been prepared for the first time in the $PuBr_3$-type orthorhombic modification by quenching from the melt. Each of the crystal forms (UCl_3-type hexagonal and $PuBr_3$-type orthorhombic) of $BkCl_3$ and $CfCl_3$ has been characterized on the basis of its solid-state absorption spectrum. The orthorhombic forms of $BkCl_3$ and $CfCl_3$ are the high-temperature modifications with respect to the hexagonal phases, with the apparent transition temperatures near the melting points of $BkCl_3$ (876 K) and CfCl# (818 K). Orthorhombic $BkCl_3$ transmutes to orthorhombic $CfCl_3$ and hexagonal $BkCl_3$ transmutes to hexagonal $CfCl_3$. Thus, it was found that both the oxidation state and the crystal structure of the parent ^{249}Bk compound were retained by the daughter ^{249}Cf compound through β decay in the bulk phase solid state. 11 references, 5 figures.

11897 **Photoelectron spectra of metal tetrakis(methyltrihydroborates) and thorium tetrakis(tetrahydroborate).** Green, J.C.; Shinomoto, R.; Edelstein, N. (Inorganic Chemistry Lab., Oxford, England). *Inorganic Chemistry;* **25**: No. 16, 2718-2720(30 Jul 1986). Contract AC03-76SF00098.

He I and He II photoelectron spectra of $M(BH_3CH_3)_4$ (M = Zr, Hf, Th, U) and that of $Th(BH_4)_4$ in the vapor phase have been obtained. Assignments of the bands based on the Xα-SW calculations of Hohl and Roesch for $M(BH_4)_4$ are given. 17 references, 5 figures, 1 table.

11898 **Assessment of resonance ionization mass spectrometry for analytical chemistry and spectroscopy.** Young, J.P.; Donohue, D.L.; Smith, D.H. (Oak Ridge National Lab., TN). *Institute of Physics, Conference Series;* No. 71, 127-133(1984). Contract AC05-84OR21400.

From RIS 1984; Knoxville, TN USA (16-20 Apr 1984).

Resonance ionization mass spectrometry (RIMS) is a natural outgrowth of RIS. The result of an RIS process is an ion pair. The electron can be used to detect the process, and single atom detection has been demonstrated by this method. The cation resulting from the RIS process actually carries more easily accessible and useful information. There are some statistically related questions as to the usefulness of single atom identification by this member of the ion pair, but certainly information obtained by RIMS has been of great value. The first published description of a RIMS process involved the demonstration of isotopic separation of potassium. The analytical application and demonstration of RIMS followed. The development of RIMS has proceeded in several different directions, using CW or pulsed lasers, narrow or wide band laser energies, different kinds of sample generation, and different kinds of mass separations. Various other presentations in this symposium address a number of these points. Their assessment of these aspects will be given in this paper, but the individual papers should be consulted for an independent understanding. Keep in mind that RIMS in various forms can be used to obtain either elemental or isotopic selectivity.

11899 **Interaction of $Np(V)O_2i$ with common mineral surfaces in dilute aqueous solutions and seawater.** Keeney-Kennicutt, W.L.; Morse, J.W. (Texas A and M Univ., College Station). *Marine Chemistry (Amsterdam);* **15**: 133-150(1984).

The extent and kinetics of NpO_2^+ adsorption from dilute aqueous solutions and seawater onto a variety of synthetic and natural solids were determined at 25°C and 1 atm total pressure. Extensive and complex adsorption reactions were found, contrary to speculations in the literature and that NpO_2^+ should behave as a simple monovalent ion with a low affinity for surfaces. When normalized to adsorption per unit solid surface area, the ranking for the synthetic solids was aragonite $\cong$ calcite > goethite >> MnO_2 $\approx$ clays. Natural materials generally followed the same behavior

patterns as their synthetic counterparts. The dissolved/adsorbed ratio was found to be constant over a wide range (10^{-3}-10^{-7} M) of NpO_2^+ concentrations. At higher concentrations the extent of adsorption decreased until a solubility limit was reached at approximately 10^{-5} M. Solution composition had the most significant influence for NpO_2^+ adsorption on goethite, where much more extensive adsorption occurs in dilute solutions than in seawater. When seawater is added to a dilute solution, extensive desorption of NpO_2^+ from geothite occurs. Tests conducted on NpO_2^+ adsorbed on carbonates indicated that it remained in the V oxidation state. There is a growing consensus that Pu dissolved in natural water also occurs dominantly in the V oxidation state as PuO_2^+ ion. Consequently, these results for NpO_2^+ may serve as a guide for Pu behavior when also in the V oxidation state. The fact that most sorbed Pu is found in the III or IV oxidation states indicates that reduction of Pu may occur subsequent to adsorption in the V oxidation state. 31 references, 10 figures, 3 tables.

11900 **Characterization of anhydrous transcurium halides by absorption spectrophotometry.** Ensor, D.D.; Young, J.P.; Haire, R.G.; Peterson, J.R. (Tennessee Technological Univ., Cookeville). *Reviews in Inorganic Chemistry;* 5: No. 4, 384-406(1983). Contract AS05-79ER10489;AS05-76ER04447.

Absorption spectrophotometry has been used to characterize the anhydrous halides of einsteinium, californium and berkelium. Extensive studies of these compounds have shown the usefulness of spectrophotometric analysis to identify the oxidation state and coordination number of the metal ions. Unlike X-ray diffraction analysis the spectrophotometric technique is relatively rapid and insensitive to the inherent radioactivity of these elements. Used in combination with X-ray diffraction data, the absorption spectra of these halides can be assigned to a particular bulk phase crystal structure. The sensitivity and interpretive abilities of absorption spectrophotometric analysis are best illustrated by its application to the study of the californium and berkelium halides produced by the decay of einstenium halides. 22 references, 12 figures, 2 tables.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 10823, 11401, 11825, 11830, 12982

11901 (CONF-8510176—, pp 84-91) **Superheating and bubble growth within multicomponent fuel droplets.** Avedisian, C.T. (Cornell Univ., Ithaca, NY). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Bubble growth measurements within superheated liquid droplets are reported at pressures and temperatures up to 13 atm and 500K, respectively. Binary and ternary mixtures of n-pentane, n-hexane, and n-decane, were studied. The experimental method involved levitating a test droplet in a flowing stream of another immiscible liquid (glycerine). Levitation was achieved by balancing the buoyancy and drag force on the droplet. Bubble formation within the droplet was induced by isothermally decompressing the field liquid to pressures approaching the homogeneous nucleation limit of the levitated droplet. It was observed that the bubble growth rate was always lower for a mixture than its components regardless of their relative volatility, and that the growth rate decreased with increasing pressure for a given mixture. Lowering the concentration of the nonvolatile component of a binary mixture and in turn replacing it by a yet more nonvolatile liquid (keeping the concentration of the volatile component constant), was found to increase the bubble growth rate above that of a mixture of any two of the ternary components. The results are discussed from the perspective of bubble growth within a liquid mixture of infinite extent.

11902 (CONF-8510176—, pp 92-98) **Dynamics of liquid fuel droplets.** Sanders, B.R.; Dwyer, H.A. (Sandia National Labs., Livermore, CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The unsteady flow field inside of and surrounding a spherical vaporizing droplet has been obtained by a numerical solution of the complete set of partial differential equations governing conservation of mass, momentum, energy and species. These computations reveal a highly nonlinear coupling between the transport processes and the unsteady gas dynamics associated with droplet deceleration by drag. Results presented for a cold droplet suddenly injected into a hot, quiescent environment show an order-of-magnitude reduction in drag coefficient as compared to the classical steady-state drag coefficient for a solid sphere. A systematic set of computations are presented which isolate the contributions to drag reduction by motion of the liquid interface, heat transfer between liquid and gas phases, mass transfer through vaporization, molecular weight difference between vaporizing species and surrounding environment, and gas-phase pressure.

11903 (CONF-8510176—, pp 99-106) **Stability and stabilization of premixed flames.** Law, C.K. (Univ. of California, Davis). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Using the symmetrical, adiabatic, counterflow arrangement, the laminar flame speeds of methane/air and propane/air mixtures, with and without the addition of stoichiometrically-small amount of hydrogen, have been determined by first measuring the flame speeds with stretch and then linearly extrapolation these values to zero stretch. Results show reduced values of the flame speed in the absence of stretch, which can better explain the available kinetic data, and that the flame speed is substantially increased with hydrogen addition. The extinction stretch rates have also been determined and their relation to flammability limits discussed. The present results provide useful information for the study of flame structures and stabilization.

11904 (CONF-8510176—, pp 107-114) **Behavior of turbulent premixed flames.** Cheng, W.K.; Hainsworth, E.; Keck, J.C.; Pope, S.B. (Massachusetts Institute of Technology, Cambridge). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The propagation of turbulent premixed spherical flame balls was examined experimentally and theoretically. High speed Schlieren movies of the flame propagation reveal a transition from a smooth laminar flame kernel to a wrinkled laminar flame surface as the flame balls grow in size. A statistical model of the turbulent premixed combustion gives results in excellent agreement with the experiment.

11905 **(DOE/ER/14953—5) Studies of combustion kinetics and mechanisms: Progress report, June 1, 1984 to December 31, 1986.** Gutman, D. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemistry). 22 Dec 1986. Contract AC02-78ER14953. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003692.

The objective of the current research is to gain new quantitative knowledge of the kinetics and mechanisms of the reactions of polyatomic free radicals which are important in hydrocarbon combustion processes. The special facilities designed and built for these studies are continually being improved, particularly to permit studies of these reactions at higher temperatures and under more controlled conditions. The major research activities during the current grant period involved studies of the kinetics and thermochemistry of the reactions of hydrocarbon free radicals with molecular oxygen, an investigation of the recombination of methyl radicals, and studies of the reactions of atoms with polyatomic free radicals. Where possible, the results of these studies were analyzed and interpreted using current knowledge of the potential-energy surfaces of these systems. This progress report contains not only a summary of the research accomplished during the current grant period but also a brief description of our improved experimental facility.

11906 **(EPA—600/7-84-001) Control of criteria and non-criteria pollutants from coal/liquid mixture combustion.** Stelling, J.H.E.; Call, S.J. (Radian Corp., Durham, NC (USA); Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). Jan 1984. Contract AI22-81PC42690. 219p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86011233.

This report presents general information on the technical, environmental, and economic aspects of CLM combustion and conversion of existing boilers to fire CLMs. Because of the site-specific nature of conversions to CWM, the trends presented here should be used only as guidelines. The results of this study suggest that potential emissions can be reduced by using conventional control technologies currently applied to oil- and coal-fired boilers. Particulate matter (PM) emissions can be effectively controlled by ESP or fabric filter. Sulfur dioxide (SO_2) and PM control can be achieved simultaneously using either wet or dry FGD systems. Nitrogen oxides (NO/sub x/) emissions can be reduced by using one or more of several combustion modification techniques or post combustion controls. In addition to these conventional means of control, PM and SO_2 emissions can also be reduced by pre-combustion techniques such as physical coal cleaning and use of naturally occurring low- sulfur, low-ash fuels. Finally, trace elements are best reduced by PM control techniques are discussed for As, Be, Cd, Cr, Ni, Se, V, and Hg.

11907 **(ESA-TT—10) Model for normal and erosive burning of composite propellants.** Godon, J.C. (European Space Agency, 75 - Paris (France)). Dec 1985. 186p. (ONERA-NT—1984-3; ETN—86-97798). NTIS, PC A09/MF A01.

Processes governing the normal combustion of composite propellants and the causes of the erosive burning phenomenon are discussed. Analytical expression of the combustion mechanisms leads to the construction of numerical models describing the autonomous combustion of ammonium perchlorate and the normal combustion of composite propellants. A first coupling with a calculation for a turbulent boundary layer with wall injection gives an evaluation of the intensification of combustion in erosive conditions, due to the existence of a high specific mass flow rate sweeping the surface. Each model is based on experimental data or data from the literature. Results show good agreement with experimental data.

11908 **(LBL—21899) Pulsed plasma jet igniters: species measurements in nitrogen and air.** Cavolowsky, J.A.; Breber, P.R.; Oppenheim, A.K.; Lucas, D. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 30p. (CONF-8610180—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87001885.

From Fall meeting of the Western States Section/Combustion Institute; Tucson, AZ, USA (27 Oct 1986).

A molecular beam mass spectrometer was used to obtain quantitative data on the species present in the core regions of nitrogen and air plasma jets. The dilution of the jet as ambient gas is entrained into the turbulent plume was measured by probing an argon jet discharging into a nitrogen atmosphere. Comparison of peak mole fractions of reactive species in the jet with the dilution results indicate that the plasma species are not decaying at a rate solely due to dilution. The nitrogen plasma jet was probed for metastable nitrogen (N_2^*) and N atoms as a function of time at various distances along the centerline of the jet. Peak mole fractions of metastable nitrogen and N atoms plotted as a function of probe location demonstrate that N_2^* persists at distances farther downstream than N atoms. Metastable nitrogen concentrations are relatively constant from 4 to 14 mm, indicating that metastable nitrogen is produced in the plume. Nitrogen atoms, oxygen atoms, and nitric oxide were measured in an air plasma. No evidence of metastable nitrogen was found in this system. The chemistry with respect to these results is discussed, both in terms of the kinetics of the system and calculated equilibrium concentrations. 28 refs., 7 figs., 1 tab.

11909 **Two-dimensional fluorescence imaging of a flame-vortex interaction.** Cattolica, R.J.; Vosen, S.R. (Sandia National Laboratories, Livermore, California, US. Combustion Research Facility). *Combustion Science and Technology;* **48**: No. 1-2, 77-87(1986).

The interaction of a methane-air flame with a vortex-ring structure was observed by means of quantitative imaging of the OH concentration using laser-induced fluorescence. The vortex-ring in the experiment was formed by an impulsive jet of gas exiting a thin-plate circular orifice separating a small cylindrical prechamber from the main combustion vessel. This impulsive jet was driven by a spark-ignited flame which propagates through the prechamber. The flame which exits the prechamber orifice follows in the wake of the vortex structure, and eventually overtakes it. The two-dimensional imaging results show the effect on the OH concentration distribution of fluid mechanic features of the vortex-ring structure: a wake flow with a shear layer, a stagnation-point flow, and a vortex core with a high rotational velocity.

11910 **Effect of elevated pressure on the rate of soot production in laminar diffusion flames.** Flower, W.L. (Sandia National Laboratories, Livermore, California, US. Combustion Research Facility). *Combustion Science and Technology;* **48**: No. 1-2, 31-43(1986).

Measurements of the axial and transverse components of velocity in two-dimensional, sooting laminar diffusion flames are presented. Laser-Doppler anemometry was used to obtain these measurements in flames which, except for the addition of alumina seed particles, were identical to 1- and 2-atmosphere flames for which comprehensive measurements of the soot volume fraction, particle size, and number density, as well as temperature, have been reported previously. The combination of the velocity results with the previous set of measurements allows us to determine the local volumetric rate of soot production, which is observed to increase with pressure.

11911 **On the stability of the porous plug burner flame.** Kaper, H.G.; Leaf, G.K.; Matkowsky, B.J. (Argonne National Laboratory, US. Mathematics and Computer Science Division). *Combustion Science and Technology;* **47**: No. 1-2, 93-101(1986).

The results of a linear stability analysis of a stationary premixed plane flame attached to a porous plug burner are presented. A dispersion relation derived by Buckmaster (1983) is used to define the neutral stability curve in the wave number vs. Lewis number plane. The nature of this curve is analyzed as the characteristic parameters of the burner and the standoff distance of the flame are varied. It is shown that the neutral stability curve may have multiple branches where pulsating flames become unstable. Depending on the parameter values, the burner may have a stabilizing or destabilizing effect.

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REFER ALSO TO CITATION(S) 12990

11912 **(RAND/R—2569/1-DOE) Pioneer plants study user's manual.** Horvath, R.E. (RAND Corp., Santa Monica, CA (USA)). Jun 1983. Contract AC01-79PE70078. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003672.

The results of the Pioneer Plants Study are summarized by two equations, one for cost misestimation and one for plant performance. This manual defines each of the above areas of information and demonstrates how they can be quantified for insertion into the equations. We use an actual waste facility as an example. Sufficient instructions are given to permit the user to repeat the procedure using a plant of choice. The information required can be obtained through interviews with the project manager for that particular plant. The results of the equations are expressed in terms of a confidence interval. An example of a sensitivity analysis shows the reader how to cope with uncertainty about the equation inputs.

11913 **(UCRL—50016-86-1) Technical abstracts for the period January-June 1986.** Woo, H.H. (ed.). (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87004218.

Twice a year the Lawrence Livermore National Laboratory (LLNL) Mechanical Engineering (ME) Department publishes Technical Abstracts to inform readers of the broad range of technical activities in the Department, and to promote an exchange of ideas. This report covers the period January through June 1986 and contains 113 abstracts.

11914 **(UCRL—50025-86-3) Electronics Engineering Department: EE technical review.** (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003973.

The EE Technical Review has two purposes - to inform readers of various activities within the Electronics Engineering Department and to promote the exchange of ideas. The articles, by design, are brief summaries of EE work.

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REFER ALSO TO CITATION(S) 10789, 10849, 11085, 11537, 11538, 11616, 12190, 12295, 12879, 13008

11915 **(AAEC/M—111) Operating procedures for the manufacture of radioactive SYNROC in the Actinide Laboratory.** Western, K.F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1986. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700451.

The purpose of this manual is to acquaint the operator with the procedures required to manufacture SYNROC-containing radioactive materials in the SYNROC Actinide Laboratory, Lucas Heights Research Laboratories. The actinide-doped SYNROC production facility is a series of four interconnected glove boxes and one free-standing glove box. The samples of radioactive SYNROC produced in the Actinide Laboratory are used to carry out physical testing of the product at various laboratories on site, e.g. leach testing, auto-radiographic examination, electron-microscopc examination, atomic absorption spectrophotometry and analysis. 20 figs.

11916 **(AD-A—172603/3/XAB) Assessment of the effects of heat and NBC (nuclear, biological, and chemical) protective clothing on performance of critical military tasks. Final report.** Fine, B.J.; Kobrick, J.L. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Jun 1985. 44p. (USARIEM-T—11/85). NTIS, PC A03/MF A01.

Chemical protective clothing seriously degrades the performance of soldiers doing physical work in the heat. However, little is known about the combined effects of heat and protective clothing on mental performance. This study examined the effects of heat on the sustained cognitive performance of sedentary soldiers clad in NBC protective clothing. Twenty male soldiers trained for two weeks on tasks resembling those performed by fire direction center, forward observer and communications personnel. Then, they performed the tasks for seven-hour periods on four successive days in hot (91 F, 61% RH) and normal (70 F, 35% RH or 55 F, 35% RH) conditions, with and without protective clothing (MOPP IV). Conclusions: The data indicate quite conclusively that after four to five hours of exposure to a moderately hot environment, the cognitive performance of a group of highly trained soldiers, clad in the MOPP IV configuration of NBC protective clothing, began to deteriorate markedly. Two individuals became heat casualties and had to be evacuated from the chamber for medical reasons. A significant number of personnel had the integrity of their protective clothing compromised by sweat after as little as three hours of exposure to heat and virtually no physical activity.

11917 **(AD-A—172878/1/XAB) Storage study of electrolyte beverage for NBC (nuclear, biological, or chemical) environment. Final technical report, April 1983-April 1985.** Howker, J.J.; Mullins; Halkiotis; Briggs; Dunne, C.P. (Army Natick Research and Development Center, MA (USA)). 30 Dec 1985. 15p. (NATICK/TR—86/062). NTIS, PC A02/MF A01.

The purpose of the project was to describe and report the effects of storage duration and temperature on NBC electrolyte beverage. The NBC electrolyte beverage stored 24 months at 4.4 C and 21.1 C was satisfactory. The product stored 9 to 12 months at 37.7 C had flavor deterioration.

11918 **(AD-A—172885/6/XAB) Advanced high-power generator research program. Final report, January 1984-October 1985.** Johnson, T.E. (AiResearch Mfg. Co., Torrance, CA (USA)). May 1986. 134p. NTIS, PC A07/MF A01.

This report summarizes work accomplished in phase III of the advanced high-power generator research and development program, F33615-76-C-2168, part of an Air Force exploratory development program for high-power airborne electrical-power-supply technology. The program includes the design of a 5-MW generator for use in a 10-MW power supply and fabrication and testing of the generator rotor. The five program phases are: phase I, design; phase II, critical component testing; phase III, rotor fabrication; phase IV, rotor testing; and phase V, test plan preparation. The overall objective of the exploratory development program is to demonstrate through prototype hardware testing, that an ultralightweight (0.1 1b/kw), nonsuperconducting generator can be successfully built in the 1-to-10-mw power range. The program was terminated at the end of phase III. This report covers the fabrication of a samarium-cobalt permanent magnet rotor which included: HIP-(hot isostatic pressure) bonding, heat treating, machining, magnet assembly, sleeve installation, and spinning.

11919 **(AD-A—173188/4/XAB) Cryogenic acoustic microscopy. Annual technical report, 1 April 1985-31 March 1986.** Quate, C.F. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Jul 1986. 35p. (GL—4068). NTIS, PC A03/MF A01.

The progress on the ultrahigh-resolution acoustic microscope is described. Two main areas are investigated: signal-to-noise ratio and a mechanical scanner. The signal-to-noise ratio (SNR) is improved by developing higher-efficiency acoustic transducers for generating coherent sound and superconducting bolometers for broadband detection of sound. Some experiments to understand the effects of pressurizing liquid helium on the propagation of high-intensity focused sound waves in superfluid helium are described. The possibility of utilizing parametric amplification of sound in liquid helium to improve the SNR is reported. Finally, the design and development of a new scanner with a wider scanning range with great precision operating in pressurized liquid helium are also described.

11920 **(AD-A—173203/1/XAB) Physiological assessments of chemical-threat protective patient wraps in three environments. Manuscript report.** Cadarette, B.S.; Speckman, K.L.; Stephenson, L.A. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). Sep 1986. 23p. (USARIEM-M—56-86). NTIS, PC A02/MF A01.

From 57. annual Aerospace Medical Association meetings; Nashville, TN, USA (20-24 Apr 1986).

Comparisons of physiological responses of eight resting supine subjects to 2-h encapsulation in the current chemical-warfare-agent protective patient wrap, and seven prototypes were conducted in a warm (T/sub db/ = 30C, T/sub dp/ = 7C) environment. Oxygen and carbon dioxide concentrations within the wrap, and the subjects rectal temperature (T/sub re/), heart rate (HR) and sweating rates were determined. The subjects sweating rates and final T/sub re/ and HR were not different among wraps. Two prototype wraps were further tested in the heat (T/sub db/ = 49C, T/sub dp/ = 17C) and cold (T/sub db/ = -39C). The chosen wraps were the wrap of Nyco twill shell and 3M melt-blown polypropylene core which showed the smallest changes in O_2 and CO_2 (final O_2 = 19.3%, CO_2 = 1.2%) of the prototypes, and the Nyco oxford shell and Bondina Mark IV core wrap which had the third smallest changes in O_2 and CO_2 levels (final O_2 = 18.8%, CO_2 = 1.6%) in the warm environment. Both wraps resulted in the smallest T sub re increase (0.2C) in the warm environment. In the heat, final O_2 concentration was greater (0.5%; p = 0.05) for the Nyco twill 3M wrap although final T/sub re/, HR and weight loss were not different between wraps. In the cold, there were no differences between the wraps in these physiological responses. These results show that the Nyco twill 3M patient wrap is equal or better than

the six prototype wraps in the warm and hot environments, and performs as well as the Bondina Mark IV in the cold.

11921 (AD-A—173296/5/XAB) **Quantum limits of superconducting heterodyne receivers. Annual report, 15 May 1985-14 May 1986.** Richards, P.L. (California Univ., Berkeley (USA). Dept. of Physics). 21 Aug 1986. 5p. NTIS, PC A02/MF A01.

The goal of this research is to produce quantum-limited SIS quasi-particle heterodyne receivers at submillimeter wavelengths. The approach used is to build prototype matching structures for 90 GHz and test them thoroughly. These matching structures will then be scaled to smaller dimensions to investigate their performance at submillimeter wavelengths. Substantial progress was made toward these goals during the first grant year.

11922 (AUC-IBT—8501) **Development of applicable methods for evaluating the safety of offshore structures. Pt. 1.** Sigurdsson, G.; Soerensen, J.D.; Thoft-Christensen, P. (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Jan 1985. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750603.

Structural reliability theory. Paper No. 9.

The main purpose of this project is to develop methods for evaluating the safety of offshore structures, such as platforms, taking into account that the reliability of offshore structures can be modelled as systems of failure elements; and further, to include the model undertainty in the system formulation. Classification and identification of failure modes are major parts of the project. Finally, the new method must be formulated so that i can be used for optimization of offshore structures. In this paper progress made during the last five months of 1984 is reported. The methods to be developed in this project will be based on the so-called β-unzipping method. In this paper the β-unzipping method is briefly described. The β-unzipping method consists of three steps. the first step is identfication of the significant failure modes. the next step is determination of a safety index for each identified failure mode. The final step is calculation of the reliability of the series system, where the elements are the identified failure modes. The corresponding computer program package UNZIP is presented and it it tested on a 3-dimensional example.

11923 (BNL—52006, pp 89-92) **Development and manufacture of ultra-fine NbTi filament wires at ALSTHOM.** Hoang, G.K.; Laumond, Y.; Sabrie, J.L.; Dubots, P. (ALSTHOM, Belfort, France). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Ultra-fine NbTi filament wires have been developed and manufactured by ALSTHOM. It is now possible to produce industrial copper - copper-nickel matrix wires with 0.6 mu m NbTi filaments for use in 50 / 60 Hz machines. Smaller filaments with diameters down to 0.08 mu m have been obtained with 254 100 filament wire samples. Studies are now being carried out on copper matrix conductors to reduce the filament diameter. The first results show that it is possible to obtain submicron filaments even in copper matrix wires.

11924 (CONF-8510176—, pp 31-38) **Dynamic plastic deformation of an infinite plate.** Youngdahl, C.K. 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

A solution is derived for the dynamic plastic response of an infinite plate subjected to a general axisymmetric pressure pulse which varies both with position and time and is applied to a time-varying areas of the plate. An approximation formula for the final plastic deformation is obtained in terms of three correlation parameters which are functions of simple integrals of the loading. The correlation parameters represent the effects of the applied impulse, the pulse shape, and the growth of the loaded region, respectively.

11925 (CONF-8510176—, pp 39-44) **Nonlinear viscoelastic energy loss characterization of cord materials.** Tabaddor, F.; Clark, S.K. (B.F. Goodrich, Akron, OH). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Cords constitute the load-bearing elements of reinforced rubber composites. They generally exhibit complex responses when subjected to the actual thermal and mechanical loading conditions. The response is generally nonlinear and sensitive to time, temperature and moisture content. To understand the nonlinear constitutive properties of rubber composites, it is essential to first deal with the cord constitutive relations. In this work, these cords are modeled as nonlinear viscoelastic materials and are treated as one-dimensional structures. This is a reasonable assumption for most practical purposes and furthermore admits more general type of constitutive relations. An experimental program is currently in progress to obtain the viscoelastic properties of these cords as functions of the prestraining, frequency and the temperature. Some limited experimental results are also presented and compared with the trends suggested by the theoretical developments.

11926 (CONF-8510176—, pp 45-51) **Energetics of interacting defects.** Herrmann, G. (Stanford Univ., CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Based on a recently derived formula for the hoop stress along the rim of a circular cavity, energy changes of interacting defects in an elastic plane were studied. In particular, the interaction of a circular cavity with a single dislocation and with two dislocations are discussed.

11927 (CONF-8510176—, pp 52-57) **Nonlinear stability control and secondary bifurcation.** Chen, S.S.; Jendrzejczyk, J.A.; Edelstein, W.; Reiss, E.L. 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Integrated theoretical and experimental studies were performed to enhance the understanding of nonlinear stability phenomena involving both fluids and solid structures and their interaction. The objectives are to contribute to the explanation of observed phenomena and, ultimately, to the solution of engineering design problems by means of stability control. The results of theoretical and experimental studies of stability control for elastic tubes conveying fluid are presented.

11928 (CONF-8510176—, pp 174-182) **Continuum damage mechanics: theory and application.** Krajcinovic, D. (Univ. of Illinois, Chicago). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The continuum damage mechanics (CDM) is a relatively novel branch of continuum mechanics providing a rational framework for the formulation of constitutive theories of solids weakened by a multitude of small crack-like defects. Some of the basic aspects of CDM are reviewed emphasizing its achievements and pointing out certain as yet unresolved issues. The presentation dwells on a number of important aspects of the theory focusing on the relation between the macroscopically measurable fluxes and the kinetics of the irreversible changes of the mesostructure of the solid. A common basis for the purely phenomenological theories is discussed and some of the problems encountered in application and parameter identification are described. Finally, an attempt is made to eliminate some of the ambiguities inherent to phenomenological theories through comparison with a micromechanically based model.

11929 (CONF-8510176—, pp 197-203) **Re-examination of atmospheres and impurity drag on moving dislocations.** James, W.; Barnett, D.M. (Stanford Univ., CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The problem of determining the steady state substitutional solute concentration about and the solute drag force upon a uniformly gliding Peierls-Nabarro edge dislocation is considered. The analysis is valid for an infinite isotropic linear elastic solid in which the solute atoms are modeled as misfitting spheres. This study differs from previous investigations in that (1) a site exclusion principle is invoked, and (2) the dislocation field is non-singular. The resulting non-linear diffusion problem is solved by a finite difference technique using the full multigrid compared with those of previous investigations.

11930 (CONF-8510176—, pp 213-222) **Descriptive lubrication model for concentrated contacts under boundary conditions.** Hsu, S.M. (National Bureau of Standards, Gaithersburg, MD). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The processes of lubrication are systematically analyzed and explained with the aid of recent experimental discoveries. Effective lubrication often involves surface chemical reactions which are dependent on contact geometry, load, speed, and environmental influences. Materials properties such as hardness, elasticity and others also affect the wear outcome. Fluid mechanics under the influence of interfacial pressures and temperatures also control a significant portion of the wearing processes. A conceptual model is proposed to link all these factors in a line of defense framework, and to discuss how wear can be predicted based on a probabilistic model. The model proposes a series of wear criteria for various combinations of chemically controlled, and materials properties controlled situations.

11931 (CONF-8510176—, pp 223-231) **Surface roughness data analysis.** McCool, M.I. (SKF Industries, Inc., King of Prussia, PA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Microcontact models for predicting the behavior of rough surfaces in tribological systems are discussed and compared. Problems in digital processing of stylus profile data to yield the input required by microcontact models, are shown to include quantization error, finite radius effect and sample spacing. The use of a simulation model for the evaluation of these effects is described and numerical results are presented for several cases.

11932 **(CONF-8511245—Pt.6) Platform designs. Offshore Northern Seas. Advanced Projects Conference 1985, Stavanger, Norway, 19-21 November 1985.** (Norsk Petroleumsforening, Oslo). 1985. 185p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87750641.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

This section of the proceedings contains five papers covering: Geotechnical aspects of Troll and impact on fixed platform design; The evolution of the concrete structure; New generation deep water structures; Future platform concepts for deep water. Separate abstract was prepared for one paper of the section.

11933 (CONF-8511245—Pt.6, pp B6 1-35) **Evolution of the concrete structure.** Eriksen, K.; Jacobsen, B.; Moksnes, J.; Schjetlein, I.O. 1985. NTIS (US Sales Only), PC A09/MF A01. File Number DE87750641.

From Offshore northern seas advanced projects conference; Stavanger, Norway (19 Nov 1985).

Concrete has been used successfully in marine structures like harbors, lighthouses and concrete ships since the early part of this century. But it was only in 1971 that concrete was introduced on a large scale to the oil industry when Phillips made the decision to apply concrete at Ekofisk in the North Sea. The paper describes the major developments which have taken place in concrete platform design and construction over the past 10-15 years. The oil industry was (and still is) fundamentally steelminded, and the Ekofisk caisson became a pioneering structure in many ways. Design rules and criteria, materials technology, construction methods, marine operations, system engineering and data processing are some of the fields where Ekofisk has paved the way for progress and development of far reaching consequences. Since Ekofisk, a total of 18 large concrete structures have been ordered for the North Sea and installed in water depths ranging from 70 to 153 m. The 18 structures are all of the gravity base type, consisting of a large caisson, which rests on the sea floor and supports a steel deck by means of shafts protruding above the water. For today and the near future the most significant areas for research and development are summarizaed by the following head words: Structural concepts, design and analysis, codes and regulations, and finally construction and materials. The record shows that concrete is a competitive and well established alternative for many medium and large depth North Sea oil and gas fields.

11934 **(DP-MS—86-86) Laboratory robotics projects in the Analytical Development Division at the Savannah River Laboratory.** Lien, O.G.; Steele, A.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 12p. (CONF-860944—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003113.

From 29. conference on analytical chemistry in energy technology; Knoxville, TN, USA (29 Sep 1986).

To encourage the application of robotics technology for routine radiobench applications, a laboratory dedicated to the research and development of contained robotic systems is being constructed. The facility will have several robots located in laminar flow hoods, and the hoods are being designed to allow the possibility for multiple robots to work together. This paper presents both the design features of the hoods and the general layout of the laboratory, and also discusses an application of a robotic system for the routine nuclear counting of gamma tube samples. The gamma tube system is presently operating in one of the routine analysis laboratories. 5 figs.

11935 **(EPRI-EL—4286-Vol.6) Improved motors for utility applications; Volume 6, Squirrel-cage rotor analysis: Final report.** Griffith, J.W.; McCoy, R.M. (General Electric Co., Schenectady, NY (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1986. 45p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920168.

An analysis of squirrel cage induction motor rotors was undertaken in response to an Industry Assessment Study finding 10% of motor failures to be rotor related. The analysis focuses on evaluating rotor design life. The evaluation combines state-of-the-art electromagnetic, thermal, and structural solution techniques into an integrated analysis and presents a simple summary. Finite element techniques are central tools in the analysis. The analysis is applied to a specific forced draft fan drive design. Fans as a category of application have a higher failure rate than other categories of power station auxiliary motor applications. Forced-draft fan drives are one of the major fan drives which accelerate a relatively high value of rotor load inertia. Various starting and operating conditions are studied for this forced-draft fan drive motor including a representative application duty cycle.

11936 (EPRI-NP—4769-SR, pp 4.119-4.131) **Designing advanced control systems for distillation columns.** Lupfer, D.E. (Autech Data systems, Pompano Beach, FL). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

The distillation unit operation is very important to the process industries. Approximately 35% of the investment in petroleum processing plants is for distillation equipment. In the chemical industries, the investment for distillation systems will range from zero to more than 70% of total plant investment. Distillation columns are one of the most difficult of all unit operations to control well. There are many interacting variables. This is the reason that large operating margins are common for these systems. Operating personnel in many plants that have minimum controls will argue that they have no problems in operating their columns. This is unusually true; however, what this really means is that they use large operat-

ing margins. Ease of operation is traded for operating efficiency. This can be much more costly than many plant managers realize. The design of advanced control systems for the columns is discussed.

11937 **(EUR—10549-FR) Ceramic (SiC) gas/gas heat exchanger: A prototype of the second generation. Experiments and achievements. Final report.** Cellier, M.; Galant, S.; Martinez, G.; Morillon, C.; Mulet, J.C. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 59p. (In French). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energie.

This project is concerned with the development of a ceramic (SiC) gas/gas heat exchanger module that can be operated up to 1200/sup 0/C. This work has been partially supported by E.E.C. under grant No. EE-B1-107-F. Within the frame of the above contract, the present study has addressed: thermal and thermo-mechanical design of a second generation design, construction of a prototype by CERAVER, installation and testing (efficiency, pressure drop, thermal shocks), techno-economical analysis of the apparatus. Based on results obtained with the first generation module, this work was most particularly oriented toward: readily unitegrating industrial constraints that make recovered thermal powers of several hundred kW feasible, considering ceramic forming techniques that allow mass production leading to a substantial gain on manufacturing cost and testing the prototype exchanger under conditions that are representative of an industrial environment. The tested module has a 30 kW power which falls much beyond the initial specifications.

11938 **(GAT-T—3397) Inspection and evaluation of 33-size compressor blades.** Rafferty, M.J. (Goodyear Atomic Corp., Piketon, OH (USA)). 14 Nov 1986. Contract AC05-76OR00001. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004214.

The blades from ten 33-size compressors were inspected during FY 1986. The cracking incidence observed in this sample of approximately 9800 blades was very low. Only twelve cracked blades were found and nine of the twelve came from only two compressors. Eighteen additional blades had porosity formations which, during initial inspection, looked like cracks.

11939 **(SLAC-PUB—4126) Radiation interlocks: The choice between conventional hard-wired logic and computer-based systems.** Crook, K.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1986. Contract AC03-76SF00515. 10p. (CONF-8602106—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003671.

From 20. mid-year topical symposium of the Health Physics Society; Reno, NV, USA (8 Feb 1986).

During the past few years, the use of computers in radiation safety systems has become more widespread. This is not surprising given the ubiquitous nature of computers in the modern technological world. But is a computer a good choice for the central logic element of a personnel safety system. Recent accidents at computer controlled medical accelerators would indicate that extreme care must be exercised if malfunctions are to be avoided. The Department of Energy has recently established a sub-committee to formulate recommendations on the use of computers in safety systems for accelerators. This paper will review the status of the committee's recommendations, and describe radiation protection interlock systems as applied to both accelerators and to irradiation facilities. Comparisons are made between the conventional relay approach and designs using computers. 6 refs., 6 figs.

11940 **(UCID—20940) Structural integrity of the basket of the TN-BRP spent fuel package.** Lo, T.Y.; Trummer, D.J.; Gerhard, M.A.; Schwartz, M.W. (Lawrence Livermore National Lab., CA (USA)). 11 Dec 1986. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003977.

An independent assessment of the basket of the TN-BRP spent fuel package, which was designed by the Transnuclear, Inc. of White Plains, New York. The assessment concentrated on the structural integrity of this basket in a postulated 30-foot drop. This assessment involved the evaluation of both the stress level and the buckling potential using several linear and nonlinear analyses and codes such as the American Institute of Steel Construction (AISC) code and the Boiler and Pressure Vesel Code of the American Society of Mechanical Engineers (ASME B and PV). Other areas studied were the thermal expansion stresses under normal transport conditions and the material properties of the basket in terms of its fatigue and fracture characteristics.

11941 **(UCRL—53773) A continuum model for the nonlinear analysis of beam-like lattice structures.** McCallen, D.B. (Lawrence Livermore National Lab., CA (USA)). 12 Sep 1986. Contract W-7405-ENG-48. 252p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87003974.

The purpose of this study is to develop an equivalent continuum model for structures which consist of beam-like lattice elements (i.e., lattices with aspect ratios like those of a solid beam). A finite element discretization of the equivalent continuum will be used to get a reduced order model of the structure. Both dynamical and statical behavior will be considered and nonlinearities will be restricted to those arising from geometrical considerations only. The development will be restricted to planar lattices and the normal assumptions of frictionless pin or rigid joints will be made for the discrete lattice.

11942 **(UCRL—95134-Rev.1) The application of angular resolved scatter to the documentation of damage to smooth mirrors.** Gillespie, C.H.; Edwards, D.F.; Stover, J.C. (Lawrence Livermore National Lab., CA (USA); Toomay, Mathis and Associates, Bozeman, MT (USA)). 30 Oct 1986. Contract W-7405-ENG-48. 12p. (CONF-860880—41-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003249.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Mirrors designed to survive exposure to damaging radiation are being irradiated and then measured to determine the mechanisms of failure and to improve the ability of analysis codes to predict an exposure damage threshold. The differences between survival and catastrophic failure are easily recognized and recorded by macro photography. However, the coal of this project is to quantify the onset of mirror degradation utilizing non contact methods that have good measurement sensitivity to small changes in reflectivity (material properties) and light scatter (roughness). A new angular resolved scatterometer is described that has an extended dynamic range and integrated analysis capable of displaying the surface power spectral density (PSD) over large bandwidths of surface spatial frequencies. Graphical displays of the scattered light power before and after exposure to the radiation are compared and integrated over equivalent spatial bandwidths of sensitivity for other instruments to compare calculated RMS roughness values.

11943 **(UCRL—95327) Developmental single-mode fiber transmission system.** Hagans, K.; Heritsch, R.; Pruett, B.; Neurath, R. (Lawrence Livermore National Lab., CA (USA)). 9 Sep 1986. Contract W-7405-ENG-48. 6p. (CONF-8609127—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000598.

From SPIE's fiber LASE '86; Cambridge, MA, USA (14 Sep 1986).

The frequency response of data links transmitting analog signals over kilometer-length graded-index optical fibers is limited to 1 GHz by fiber bandwidth. System bandwidths can be substantially increased if single-mode fibers are used. In the developmental system presented here, a 1-km single-mode optical fiber is used to transmit an intensity-modulated 810-nm optical signal to a streak camera recorder. Useful system bandwidth could extend to 5 GHz.

11944 (UCRL—95672) Modernizing LLNL [Lawrence Livermore National Laboratory]'s machine parts storage, retrieval, and inventory system. Locke, S.N. (Lawrence Livermore National Lab., CA (USA)). 11 Nov 1986. Contract W-7405-ENG-48. 9p. (CONF-861199—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002808.

From Interagency mechanical operations group fall meeting; Livermore, CA, USA (11 Nov 1986).

In 1985, Machine Tool Services decided it was time to upgrade the current spare parts storage system. A product was seen at a tool show that appeared to be the answer to our modernization needs. After some investigation, a vertical storage and retrieval system was purchased. In this discussion, the author explains what the parts system was, what it is, what it will be, and recommendations for buying a new storage system. It is felt that modernizing the parts inventory system would enable Machine Tool Services to be a more efficient operation, providing savings in time, cost, and space.

11945 One-third (period three) harmonic generation in microwave-driven Josephson tunnel junctions. Hansen, J.B.; Clarke, J.; Mygind, J.; Ovsyannikov, G.A.; Svensmark, H. (MIDIT (Modellering, Ikke-Lineaer Dynamik og Irreversibel Termodynamik), Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark). *Applied Physics Letters;* **49**: No. 25, 1744-1746(22 Dec 1986).

One-third harmonic signals have been generated in the zero voltage state of a Josephson tunnel junction driven with a microwave current in the frequency range 8—20 GHz. The signal was as much as 50 dB above the noise level of the detector with a linewidth of less than 100 Hz. The junction parameters and microwave current were measured in situ in separate experiments. The subharmonic generation occurred for ranges of microwave current and frequency that were in reasonable agreement with the results of digital computer simulations.

4203 Lasers

11946 (AD-A—172580/3/XAB) Effect of beam quality on the free-electron laser. Memorandum report. Freund, H.P.; Ganguly, A.K. (Naval Research Lab., Washington, DC (USA)). 29 Aug 1986. 15p. (NRL-MR—5770). NTIS, PC A02/MF A01.

The effect of finite momentum spread on the free-electron laser amplifier is investigated for a configuration of a helical wiggler and an axial-guide magnetic field. A set of coupled nonlinear differential equations in three dimensions describing the evolution of the electron trajectories and the radiation field is derived and solved numerically for several sets of parameters. The initial beam distribution is defined external to the wiggler field and the adiabatic injection of the beam into the wiggler is modeled by allowing the wiggler amplitude to increase slowly from zero to a constant amplitude over several wiggler periods. While the efficiency is found to decrease rapidly with increasing momentum spread, resonant effects between the wiggler and guide magnetic fields are found to substantially decrease the sensitivity of the saturation efficiency to the beam emittance. In addition, a relatively sharp change in the slope of the efficiency versus beam momentum spread is identified with the transition between the cold and thermal beam regimes.

11947 (AD-A—172605/8/XAB) Spectral linewidth of semiconductor lasers. Harrison, J.; Mooradian, A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1986. 11p. (MS—7096). NTIS, PC A02/MF A01.

The semiconductor diode laser (SL) has a number of properties that make it a desirable light source for spectroscopy. Aside from the advantages in size, cost, and complexity, SL's cover a broad spectral range and may easily be modulated at rates up to several gigahertz. However, coherence remains an issue in many applications. Here the issue of the ultimate SL linewidth is considered. Included is a discussion of SL spectral characteristics including the enhanced Lorentzian linewidth, the power-independent linewidth, and the fine structure in the field power spectrum. Also discussed are the prospects for line narrowing through active frequency control and present heterodyne measurements between two independently operating external-cavity (GaA1)As lasers. Finally, such stable, narrow-line sources can easily be phase-locked.

11948 (AD-A—172933/4/XAB) Self-induced frequency scanning and distributed Bragg reflection in semiconductor lasers with phase-conjugate feedback. Cronin-Golomb; Yariv. (Ortel Corp., Alhambra, CA (USA)). Jul 1986. 4p. NTIS, PC A02/MF A01.

A GaA1As semiconductor laser with feedback from a barium titanate photorefractive ring passive phase-conjugate mirror can be made to perform repeating or nonrepeating frequency scans over a 10-nm range toward either the blue or the red. The direction of scanning and whether the scans repeat may be controlled by adjusting the overlap of the interaction beams in the crystal. This overlap region may be adjusted so that the diode frequency spectrum, originally occupying about 10 longitudinal modes, scans and narrows as the conjugate signal builds up, coming to rest often in one, but sometimes two or three, longitudinal modes as a result of self-generated distributed-feedback effects. Also reported similar effects caused by feedback from the total-internal-reflection passive phase-conjugate mirror. The alignment-control mechanism of the ring mirror is, however, not available in this case.

11949 (AD-A—173055/5/XAB) Multimode dynamics in a free-electron laser with energy shift. Technical report, 1 October 1985-30 December 1986. Elias; Gallardo. (California Univ., Santa Barbara (USA). Quantum Inst.). 1986. 9p. (TR—61). NTIS, PC A02/MF A01.

A one-dimensional, multimode self-consistent phenomenological theory for a free-electron laser (FEL) oscillator is investigated numerically. The fundamental equations of an FEL are supplemented with a discontinuous decrease of the electron beam energy at each successive round trip in the cavity. The laser power exhibits oscillations produced by the growth and decay of longitudinal modes evenly distributed in frequency. The model underlines the basic mechanism operating in the University of California, Santa Barbara free-electron laser.

11950 (AD-A—173130/6/XAB) Red SOX (singlet oxygen) laser: a chemically-pumped, 0.76-micrometer singlet oxygen laser. Final report, 1 July-31 December 1985. Busch, G.E.; Knickelbein, M.B. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 28 Feb 1986. 37p. NTIS, PC A03/MF A01.

The feasibility of a red singlet oxygen laser based on production of (b) state singlet oxygen by the electronic energy pooling reaction of (a) state singlet oxygen was investigated. A microwave discharge-flow system for studying the quenching kinetics of (b) state oxygen was constructed with a large-diameter viewing region so as to ensure that heterogeneous quenching of both (a) and (b) state oxygen was unimportant. An upper bound for quenching of (b) state oxygen by (a) state oxygen was measured and was not found to be extremely large compared to the rate constant for quenching of (b) state oxygen by ground-state oxygen. The rate constants for quenching of both (b) state oxygen and (a) state oxygen by ground-state oxygen was measured. Both rate constants agreed well with those measured by previous workers. The results suggest that the extent of the effective population inversion of (b) state oxygen-produced energy pooling will not be suppressed by the high densities of (a) state oxygen initially present. The measurements reported here support the feasibility of the red singlet oxygen (Red SOX) laser, and further research and development toward this goal is recommended.

11951 (AD-A—173147/0/XAB) UCSB (University of California Santa Barbara) two-stage FEL (free-electron laser) experiment. Technical report No. 63, 1 October 1985-30 December 1986. Kimel; Elias, L.R.; Ramian. (California Univ., Santa Barbara (USA). Quantum Inst.). 1986. 9p. (TR—63). NTIS, PC A02/MF A01.

A two-stage FEL experiment is under development at the UCSB FEL facility. The experiment uses a high-quality 20-ampere electron beam generated by an electrostatic accelerator with beam recovery. A new gun and collector were developed for this experiment. The first stage, with a helical undulator, will produce a saturation flux of the order of 10^7 watts/cm^2 radiation. This will be the

pump for the second stage where light of 1.08 micrometers will be generated.

11952 **(AD-A—173232/0/XAB) Population inversion and gain measurements for soft x-ray laser development in a magnetically confined plasma column. Final progress report, 1 November 1983-30 September 1985.** Suckewer. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1985. 40p. NTIS, PC A03/MF A01.

The following was accomplished in the x-ray laser experiments underway: 1) A new optical system was built for the CO_2 laser that allowed an order-of-magnitude higher power density in the focal plane. 2) The time evolution of the laser pulse was improved. 3) Work continued on the jet-stream gas target. 4) A number of carbon targets were developed and tested. 5) EUV axial and transverse instruments were modified for measuring line intensities as a function of time. 6) Modifications were made to the computer simulation code. 7) Single-pass gains of between 2.8 and 3.5 were made for various carbon targets.

11953 **(AD-A—173270/0/XAB) Off-axis electron orbits in realistic helical wigglers for free-electron-laser applications.** Fajans, J.; Kirkpatrick, D.A.; Bekefi, G. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Dec 1985. 7p. NTIS, PC A02/MF A01.

Off-axis electron orbits in free-electron-laser beams of finite thickness, subjected to combined helical wiggler and axial-guide fields, were studied analytically. A semi-empirical equation for the electron-velocity components, averaged over the electron's oscillatory(betatron) motion, was derived as a function of the radial displacement of the radial displacement of the electron guiding center. The predictions from the equation are compared with single-particle numerical simulations, and with free-electron-laser experiments. Good agreement is found.

11954 **(AD-A—173375/7/XAB) Current research in optical pumping.** Berman, P.R. (New York Univ., NY (USA). Dept. of Physics). Dec 1985. 9p. NTIS, PC A02/MF A01.

In 1950, Professor Alfred Kastler described the way in which optical fields could be used to redistribute population among the Zeeman sublevels of a given atomic state. The optical-pumping process discovered by Kastler continues to be a research topic of current interest. With developments in laser spectroscopy, it has become important to understand the interplay of optical pumping, transit time, and collisional effects to properly interpret experimental line shapes. A brief review of the current status of the theory is given, with special emphasis on what, as yet, appear to be unresolved problems. Velocity-selective optical pumping and collision-induced resonances are discussed.

11955 **(AD-A—173461/5/XAB) Observation of single-mode operation in a free-electron laser. Technical report, 1 October 1985-30 December 1986.** Elias, L.R.; Ramian; Hu; Amir. (California Univ., Santa Barbara (USA). Quantum Inst.). Oct 1986. 5p. (TR—64). NTIS, PC A02/MF A01.

Time-structure and frequency-spectrum measurements of the UC Santa Barbara free-electron-laser oscillator show that for periods shorter than 5 microsec. The laser operates in a stable single-cavity mode having a strikingly small fractional frequency bandwidth of 10^9. This constitutes the first demonstration of high-temporal-coherence operation of a free-electron laser. For periods longer than 5 microsec, the laser-frequency changes in unexpected quantized steps, which may be explained in terms of a homogeneously broadened gain profile coupled to a small monotonic drift in electron-beam energy.

11956 **(BNL—38939) Three dimensional modelling and numerical analysis of super-radiant harmonic emission in FEL (optical klystron).** Gover, A.; Friedman, A.; Luccio, A. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 30p. (CONF-8609131—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003208.

From 8. international free electron laser conference; Glasgow, UK (1 Sep 1986).

A full 3-D Analysis of super-radiant (bunched electron) free electron harmonic radiation is presented. A generalized form of the FEL pendulum equation was derived and numerically solved. Both spectral and phasor formulation were developed to treat the radiation in the time domain. In space the radiation field is expanded in terms of either a set of free space discrete modes or plane waves. The numerical solutions reveal some new distinctly 3-D effects to which we provide a physical explanation. 12 refs., 9 figs., 5 tabs.

11957 **(ENST—5E012) Optical properties and interfaces of GaAs/GaAlAs quantic sinks. Ph.D. Thesis.** Meynadier, M.H. (Ecole Nationale Superieure des Telecommunications, 75 - Paris (France)). Dec 1985. 131p. (In French). (ETN—86-97633). NTIS, PC A07/MF A01.

Phenomena linked to the nature of the interfaces of GaA/GaAlAs quantic sinks in extremely thin layer superlattice structures are studied. The experimental analysis of photoluminescence and excitation spectroscopy was carried out using a Kr laser, a double network monochromotor, a cryostat, and optical equipment. The band discontinuities for several specimens is determined experimentally, showing that the inclusion of acceptors in the interfaces is better explained by a solubility difference than by lattice configurations. Acceptors are found in the barrier, probably due to exodiffusion phenomena. Optical relaxation phenomena are interpreted.

11958 **(ESA-CR(P)—184) Coherent infrared detection, volume C. Final report.** Ullrich, A.G.; Leeb, W.R.; Scholtz, A.L. (Technische Univ., Vienna (Austria)). Aug 1985. 77p. (ETN—86-97784). NTIS, PC A05/MF A01.

A diode laser heterodyne/homodyne receiver for optical detection of infrared radiation is discussed. The influence of finite laser linewidth caused by optical phase noise on coherent receivers is treated. For a homodyne receiver based on an optical phase-locked loop, the achievable bit-error-rate is calculated, with the phase noise and the shot noise as parameters. Electronics for GaAlAs laser diode temperature and current control were built, resulting in laser frequency long-term stability on the order of 10 MHz. An arrangement for external phase modulation was set up. Experiments reducing the solitary laser linewidth of 8 MHz to 200 kHz in a 3 mirror cavity were performed, and a criterion for controlling the position of the external mirror was found. It is concluded that the relatively large linewidth of solitary diode lasers and the complexity of linewidth reduction concepts outweigh the inherent advantages of homodyne reception.

11959 **(ETN—6-97375) Marx generator: KrF laser. Ph.D. Thesis.** Rijntjes, J.P.H. (Technische Hogeschool Twente, Enschede (Netherlands)). Apr 1984. 45p. (In Dutch). NTIS, PC A03/MF A01.

The impact of dimensioning and material choice upon a vacuum diode, consisting of a cathode with a hollow coaxial anode inside, was investigated using an optically triggered Marx generator with a 120 J maximum power capacity and a 50 nsec pulse length. The effects of different division pressure of Ar, Kr, and Fl upon the output power of the laser were examined in this set-up, in which accelerated electrons were provided in the anode for excitation or ionization of the Ar-gas. Measurements to determine the effects of different diode impedances upon the output power were carried out.

11960 **(SAND—86-2458C) Injection-seeding studies of diode laser array behavior.** Hohimer, J.P.; Hadley, G.R.; Owyoung, A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870220—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002051.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

By optical injection seeding of diode laser arrays with the output from a narrowband tunable master oscillator, we are able to actively probe these devices and study their inter-element coupling behavior and eigenmodes.

11961 (SAND—86-2485C) Thermal effects in gain-guided diode laser arrays. Hadley, G.R.; Hohimer, J.P.; Owyoung, A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870220—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87001735.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

We present calculations of the effects of junction heating on both the wave profiles and the modal gains of the eigenmodes of a gain-guided diode laser array. 11 refs., 3 figs.

11962 (UCRL—15798) Process development for applying a cladding glass to the edges of GSGG crystals: Final technical report. Izumitani, T.; Meissner, H.E.; Toratani, H. (Hoya Optics, Inc., Fremont, CA (USA); Lawrence Livermore National Lab., CA (USA)). 28 Feb 1986. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003888.

Conditions have been determined at which GSGG crystal slabs can be provided with a cast edge cladding. Breakage of the crystal can largely be avoided with the present process. Additional safety for the crystal slab may be gained by acid strengthening it. Bubbles at the interface can be reduced to a level which is probably acceptable, i.e., about 100 bubbles/cm^3 of a diameter usually below 20μm. Devitrification of cladding glass did not occur. The surface of the clad crystal appeared distorted when checked interferometrically. Strain birefringence still remains a serious problem. Edge cladding and crystal are bonded without gaps.

11963 (UCRL—95089) Soft x-ray laser cavities. Ceglio, N.M.; Stearns, D.G.; Hawryluk, A.M.; Barbee, T.M.; Danzmann, K.; Kuehne, M.; Mueller, P.; Wende, B.; Stearns, M.B.; Petford-Long, A.K. (Lawrence Livermore National Lab., CA (USA); Physikalisch-Technische Bundesanstalt, Berlin (Germany, F.R.). Inst. Berlin; Arizona State Univ., Tempe (USA)). 8 Jul 1986. Contract W-7405-ENG-48. 21p. (CONF-8604224—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003438.

From International colloquium on X-ray lasers; Aussois, France (14 Apr 1986).

We report progress in the development of multilayer components for use in multiple pass soft x-ray laser cavities operating in the 100A to 300A spectral range. Our work includes fabrication and characterization of multilayer components; simple resonant cavity design; damage threshold assessment for multilayers in the x-ray laser environment; and multipass cavity experiments for efficiency enhancement and transverse mode selection. 14 refs., 9 figs.

11964 (UCRL—95396) Prospects for x-ray laser applications. Trebes, J. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 22p. (CONF-8604224—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003252.

From International colloquium on X-ray lasers; Aussois, France (14 Apr 1986).

The prospects for the near term application of current x-ray lasers are examined. Four areas of application are discussed: (1) grating production, (2) photo-ionization laser physics, (3) contact microscopy, and (4) holography. Evolutionary rather than revolutionary progress is shown to be possible in grating production and contact microscopy. The photo-ionization experiment discussed is not possible without an x-ray laser. Dramatic progress is potentially possible in x-ray holography, but numerous difficulties make this a long-term problem requiring significantly improved x-ray lasers.

11965 (UCRL—95516) Precision cutting and drilling with the Nd-YAG laser. Lingenfelter, A.C.; Anglin, C.D.; Westrich, C.N.; Murchie, J.R. (Lawrence Livermore National Lab., CA (USA). Mechanical Engineering Dept.). Oct 1986. Contract W-7405-ENG-48. 10p. (CONF-861197—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001359.

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

The capability of focusing large amounts of energy onto a very small area makes the laser a useful tool for cutting and drilling materials. With the aid of appropriate aperture, lens, and careful selection of laser parameters, we have been successful in cutting slots 0.001 inches (0.025 millimeters) in width and drilling holes 0.00015 inches (0.0038 millimters) in diameter. Examples of these applications are shown. Cutting and drilling of foil thicknesses (less than 0.010 inches thick) poses a special problem. Despite careful selection of operating parameters there is normally some small amount of dross adhering to the bottom surface of the foil. We have found that various surface coatings can be used to protect the foil from damage both during processing and cleanup. Several examples illustrate the surface quality of cuts achieved with coated foils.

11966 (UCRL—95775) Waveguide suppression of the free electron laser sideband instability. Yu, S.S.; Sharp, W.M.; Fawley, W.M.; Scharlemann, E.T.; Sessler, A.M.; Sternbach, E.J. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 10 Sep 1986. Contract W-7405-ENG-48;AC03-76SF00098. 23p. (CONF-8609131—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003396.

From 8. international free electron laser conference; Glasgow, UK (1 Sep 1986).

A theoretical analysis is given of an FEL operating in the millimeter range and, hence, operating in a waveguide. For study of the situation in which the average longitudinal velocity of electrons v/sub parallel/ is close to the electromagnetic pulse group velocity v/sub g/, it is shown that the usual paraxial approximation is invalid. The complete analysis is then specialized to a single particle model which, for operation in a steady state, yields a dispersion relation. The resulting dispersion relation is analyzed analytically and numerically. It is shown that when v/sub parallel/ $\cong$ v/sub g/ there is no sideband instability, and an analytic expression is given for the stability boundary. 10 refs., 7 figs.

11967 Fiber optics interface for a dye laser oscillator and method. Johnson, S.A.; Seppala, L.G. (to Dept. of Energy, Washington, DC). US Patent 4,627,068. 2 Dec 1986. Filed date 13 Jun 1984. v.p.

This patent describes a lasing arrangement including a dye chamber defining a given zone having a cross sectional configuration which displays fixed lengthwise and widthwise dimensionals and through which a continuous stream of dye flows in one direction while the zone is being illuminated by light from a first pumping beam which is directed into the zone along a second direction and which causes the dye to laser within the zone. The arrangement also includes means to produce or amplify a dye beam extending in a third direction. The improvement described here comprises: (a) means for producing pump beams of lower power and different frequencies than the first pumping beam; (b) a light multiplexing assembly including optical fiber means having an output end for combining the lower power beams into a single beam which exits the optical fiber means at its output end and which serves as the first pumping beam; and (c) light coupling means connected with the output end of the optical fiber means for optically directing the first pumping beam into the dye chamber zone to illuminate the zone with light from the first pumping beam. The light coupling means includes optical means for causing substantially all of the light from the first pumping beam to be directed substantially uniformly into the cross sectional configuration. The optical means includes means for optically imaging one dimension of the first pumping beam, as the one dimension appears at the output end of the optical fiber means, into the widthwise dimension of the zone.

11968 Measurements of losses and lasing efficiency in GSGG:CR,Nd and YAG:Nd laser rods. Caird, J.A.; Shinn, M.D.; Kirchoff, T.A.; Smith, L.K.; Wilder, R.E. (Lawrence Livermore National Laboratory, P.O. Box 5508, Livermore, California 94550). *Applied Optics;* **25**: No. 23, 4294-4305(1 Dec 1986). Contract W-7405-ENG-48.

Laser rods procured from four different vendors were examined to assess the state of the art in GSGG:Cr,Nd crystal growth. Measurement techniques included spectrophotometry (for absorption loss), interferometry (for distortion), polarimetry (for birefringence), and laser resonator insertion. Free running laser efficiency measurements were also performed. The level of losses characteristic of currently available GSGG:Cr,Nd laser rods was generally found to be much higher than that of commercially grown

YAG:Nd. The intrinsic lasing efficiency of the co-doped GSGG rods, however, was typically found to exceed that of the YAG:Nd rods by more than a factor of 2.

11969 **High-efficiency extraction of microwave radiation from a tapered-wiggler free-electron laser.** Orzechowski, T.J.; Anderson, B.R.; Clark, J.C.; Fawley, W.M.; Paul, A.C.; Prosnitz, D.; Scharlemann, E.T.; Yarema, S.M.; Hopkins, D.B.; Sessler, A.M. (Lawrence Livermore National Laboratory, Livermore, California). *Physical Review Letters;* **57**: No. 17, 2172-2175(27 Oct 1986). Contract W-7405-ENG-48.

We have substantially increased the output power and extraction efficiency of a free-electron laser operating at 34.6 GHz by tapering the wiggler magnetic field. In the exponential-gain regime, the laser exhibited a measured gain of 34 dB/m. With a 50-kW input signal, the amplifier saturated in 1.3 m with a 180-MW output signal. By using a taper that brought the magnetic field at the end of the wiggler down to 45% of its initial (peak) value, we increased the output signal to 1.0 GW. This corresponds to an extraction efficiency of 34%.

11970 **Evolution of long pulses in a tapered wiggler free-electron laser.** Goldstein, J.C. (Los Alamos National Lab., X-1, MS E531, Los Alamos, NM 87545). pp 2-10 of Free-electron generators of coherent radiation. Brau, C.A.; Jacobs, S.F.; Scully, M.O. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1984). (CONF-830693—).

From Society of Photo-Optical Instrumentation Engineers conference; Bellingham, WA, USA (26 Jun 1983).

The evolution of a long pulse (pulse length much greater than the slippage distance) in a tapered wiggler free-electron laser is studied by numerical solution of the 1-D theoretical model for a realistic set of magnet, electron beam, and optical resonator parameter values. Single-pass gain curves are calculated for low and high light intensity. The authors find that an initial, low-amplitude, incoherent pulse grows into a coherent pulse whose growth rate agrees with the calculated small signal gain. The transient evolution of coherent pulses is calculated for several different cavity length detunings, and a quasi steady-state desynchronism curve is given. The frequency changing behaviour of the optical pulse is shown to occur through sideband generation associated with synchrotron oscillations. Pulse evolution with an ideal intracavity high-pass optical filter is calculated.

11971 **Comments on Shakir's zero-area optical pulse processing by degenerate four-wave mixing.** Suydam, B.R.; Fisher, R.A. (Los Alamos National Lab., NM). *Optics Communications;* **45**: No. 4, 285-287(15 Apr 1983).

The authors disagree with one of the contentions of Shakir's paper, namely that a zero-area pulse can be generated by an unstable phase conjugator. They find, on the contrary, that any unstable conjugator would, if the pumps were not depleted, generate a conjugate wave of infinite area. They show by counterexample that the response generated by Shakir's technique is noncausal if the conjugator is unstable.

11972 **Approaches to the development of gamma-ray lasers.** Baldwin, G.C.; Solem, J.C.; Gol'danskii, V.I. (Los Alamos National Lab., NM). *Reviews of Modern Physics;* **53**: No. 4, 687-744(Oct 1981).

The interdisciplinary theoretical and practical problems involved in the development of devices analogous to lasers for generation of coherent radiation in the 6- to 120-keV photon energy range by stimulated emission of recoil less radiation from nuclear isomers are discussed. Appendices are included offering information on the following: Conventions, Constants, and Symbols; Nuclear Isomers; Cross Section or Induced Isomeric Transitions; The Mossbauer Effect; Line Broadening; Nonresonant Photon Absorption; Photon Channeling in Crystals; The Criterion for Stimulated Emission Gain; Narrow-Line Laser Kinetics; Neutrons as Pumping Radiation; and Isomer Enrichment by Atomic Beam. 332 references, 17 figures, 5 tables.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 10706, 11153, 11374, 11702, 11927, 12910

11973 (CONF-8510176—, pp 1-8) **Helical and fractal nature of fully developed turbulence.** Levich, B.; Levich, E. (City College of The City Univ. of New York, NY). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The main feature of fully developed turbulence is its dual nature - the existence of vast areas of relatively quiescent vortical flow (large coherent structures and intermittencies) and smaller spots or bursts of violent ostensibly chaotic behavior embedded among quiescent areas. In the light of these properties of fully developed turbulence the following problems are discussed: (1) recognizing basic elementary statistical units compatible with the dual nature of turbulence, i.e., understanding and quantitative description of large coherent structures and small scale intermittencies and nature of burst of violent activity; and (2.) formulation of model equations more simplified as compared with Navier-Stokes (NS) equation and amenable to computer simulation but still capable of describing the main features of large scale turbulence - the last is most important from the engineering point of view.

11974 (CONF-8510176—, pp 9-15) **Contact propagation processes in heterogeneous media.** Kerstein, A.R.; Edwards, B.F. (Sandia National Labs., Livermore, CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

An analogy between transport (diffusion or conduction) and propagation (as of a chemical reaction front) in heterogeneous media motivates the introduction of a new propagation regime, denoted contact propagation. Scaling laws governing contact propagation are proposed and are confirmed by means of computer simulations. The scaling laws are shown to govern propagation in media whose properties vary temporally as well as spatially, indicating the applicability of the scaling laws to stirred fluids as well as solids.

11975 (CONF-8510176—, pp 16-23) **Characterization of chaotic processes.** Swinney, H.L.; Swift, J. (Univ. of Texas, Austin). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Methods are being developed to analyze strange attractors, which are the phase space portraits that describe chaotic behavior of nonequilibrium systems. Techniques for constructing the attractors and computing Lyapunov exponents, mutual information, and fractal dimension have been developed and tested on mathematical models and applied to laboratory data for chemical reaction in a stirred flow reactor and other nonequilibrium systems. These complex physical systems are found to be described by low dimensional strange attractors; that is, only a few degrees of freedom are necessary to describe the chaotic behavior.

11976 (CONF-8510176—, pp 58-65) **Heat-transfer effects of a longitudinal vortex embedded in a turbulent boundary layer.** Eibeck, P.A.; Eaton, J.K. (Stanford Univ., CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Longitudinal vortices occur in numerous practical devices where an understanding of their effect is complicated by several interacting phenomena. The purpose of the present experimental investigation is to isolate the effects of a longitudinal vortex by embedding a single vortex in an otherwise two-dimensional turbulent boundary layer. The experiments are conducted in a low-speed wind tunnel. The heat-transfer coefficient was measured using a constant-heat-flux, thin foil surface instrumented with 160 thermocouples. Fluid dynamic data were measured using multiple-hole pressure probes, a single hot-wire probe, and a miniature fence probe for skin-friction measurement. Heat-transfer results showed local increases of the Stanton number of approximately 25% in re-

gions where the boundary layer is thinned. Local decreases of the Stanton number as large as 14% were observed in upwash regions. The boundary-layer profiles imply that, at a given spanwise position, the flow behaves like a two-dimensional, turbulent boundary layer, at least through the log region.

11977 (CONF-8510176—, pp 66-74) **Numerical simulations of turbulent heat transfer in the presence of shear.** Domaradzki, J.A.; Metcalfe, R.W. (Flow Research Co., Kent, WA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Direct numerical simulations of turbulent convection with shear were performed. The effect of shear is to reduce randomness of convection and introduce anisotropy in horizontal directions by aligning large scale structures in the direction of the mean velocity. The presence of shear decreases the total heat transfer and the departures from the linear profiles of mean temperature and velocity. It is also shown that the pressure diffusion term plays an important role in the energy balance equation and should not be neglected in turbulence models.

11978 (CONF-8510176—, pp 75-83) **Examination of mixed and natural convection in a cavity.** Koseff, J.R.; Street, R.L.; Freitas, C.J.; Rhee, H. (Stanford Univ., CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Two facilities, an experimental Lid-Driven Cavity and a three-dimensional hydrodynamical numerical code (REMIXCS) are presently being used to study mixed and natural convection flow. The cavity provides a well-controlled natural, forced or mixed convection environment while the numerical code solves a weak form of the Navier-Stokes equations plus a heat transport equation via a weighted residual method. Four examples of calculations with REMIXCS are presented; an isothermal shear-driven flow, a natural convection flow (lower-boundary is heated), a mixed convection flow (combination of first two flows), and a natural convection flow in which the side-wall is heated. Experiments were performed for the first three cases using the lid-driven cavity facility. Longitudinal Taylor-Goertler-like vortices, present in the isothermal and mixed convection flows, are important to the heat and momentum transfer processes in the flow. The (lower-boundary heated) natural convection flow is dominated by thermal plumes while the side-wall heated flow exhibits a very curious and striking result in the early stages of its formation. In general, agreement between the physical and numerical experiments is good although in many cases the differences between the time-averaged (experiment) and instantaneous (numerical) results is significant. In future studies the important parameter ranges for the mixed and natural convection flows will be examined.

11979 (CONF-8510176—, pp 115-121) **Rheology of concentrated suspensions of solid spheres.** Acrivos, A. (Stanford Univ., CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

It has been tacitly assumed up to now that a two-phase material consisting of monodisperse solid spheres freely suspended in a viscous Newtonian liquid, behaves as an effective Newtonian fluid having an effective viscosity whose value relative to that of the pure solvent is only a function of the solids concentration phi, provided that nonhydrodynamic forces are of minor importance. Experimental evidence is presented, however, which clearly demonstrates that, when phi $>$ 0.3, such suspensions exhibit significant non-Newtonian characteristics, e.g. normal stresses, a nonlinear response to oscillation, and memory effects. These experimental findings are consistent with the notion that such systems, when sheared, develop a structure which render them anisotropic fluids. The role of shear induced particle migrations and their influence on viscometric measurements is also discussed.

11980 (CONF-8510176—, pp 122-129) **Shear-induced instabilities in a double-diffusive partially stratified fluid: experimental set-up.** Zangrando, F.; Munoz, D. (Solar Energy Research Institute, Golden, CO). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The first year of a study on the combined effects of mass and heat diffusion, convection due to bottom heating, and shear by a superposed cross flow on the convective and entrainment characteristics in a double-diffusive, thermohaline system is discussed. Goals for the first year were to modify, reinsulate, instrument and calibrate an existing test tank; to review the pertinent literature; to initiate the test sequence; to begin observing the nature of the flow fields established in the tank; and to observe the mixing and entrainment mechanisms at the interface between either a single- or a double-diffusive stratification and a mixed region. Results of tests conducted with bottom heating of a double-diffusive stratification and with jet discharge into a mixed layer below a single-component stratification agree with previous results.

11981 (CONF-8510176—, pp 130-136) **Prediction of liquid mixture thermal conductivities and shear viscosities.** Rowley, R.L. (Brigham Young Univ., Provo, UT). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

A local-composition model has been developed for prediction of liquid mixture thermal conductivity and shear viscosity. The model accounts for deviations from an ideal mixing rule of pure component values with nonrandom-mixing effects, or localized structure, due to differences in like and unlike molecular interactions. NRTL parameters readily available from either tabulations or vapor-liquid equilibrium measurements are used to provide the local-composition information. It is assumed that the same local structure, hence, the same NRTL parameters are also valid for transport properties. Additionally, a strength of interaction effect is included for shear viscosity calculations through the Eyring model. These calculations require binary heat of mixing data. Binary and ternary liquid mixture thermal conductivities and shear viscosities have been measured in this laboratory using a transient hot wire cell and a Schott Ubbelohde capillary viscometer, respectively. Measured values have been used to test the model. It appears that binary and ternary transport properties are predicted quite accurately using the local-composition model and the aforementioned binary equilibrium data with no parameters obtained from the transport properties themselves.

11982 (CONF-8510176—, pp 137-145) **Free convection heat transfer in the critical region of the binary fluid mixtures.** Jump, D.; Marschall, E. (Univ. of California, Santa Barbara). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Free convection heat transfer from a heated wire to near critical binary mixtures of R-22 and R-115 was investigated experimentally. Measurements included determination of mixture bulk temperature and pressure, wire temperature and heat flux at the wire surface, and mixture concentration. Modest peaks in heat transfer coefficients were found at small temperature differences for all mixtures. For bulk fluid temperatures slightly below their critical temperatures boiling-like phenomena were observed and the corresponding maximum heat transfer coefficients were found to be up to 600% higher than those obtained at larger temperature differences.

11983 (CONF-8510176—, pp 183-196) **Transport phenomena in porous media: single and two phase flow.** Catton, I.; Georgiadis, J.; Lee, H.; Mirzamoghadam, A. (Univ. of California, Los Angeles). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Several aspects of transport phenomena in porous media are reported. The Darcian motion equation is extended to account for

inertia effects and boundary effects and their importance is shown. Experimental and analytical studies of two-phase flow in porous media are used to develop a two-fluid model and to explain unexpected observed phenomena.

11984 (CONF-8510176—, pp 240-247) **Pulsating flow and heat transfer over multiple cylinders.** VandenBerghe, T.M.; Dhaubhadel, M.N.; Diller, T.E.; Telionis, D.P. (Virginia Polytechnic Institute and State Univ., Blacksburg). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The fluid mechanics and heat transfer of a triad of cylinders in steady and pulsating flow was investigated. Tests conducted in a wind tunnel provided data on velocity, pressure, and skin friction distribution, as well as averaged heat transfer. Tests in a water tunnel generated flow visualizations. The results indicate that there are specific patterns of organization of the separated regions which are dominated by the shedding characteristics of the first two cylinders. It was found that flow pulsations at the natural shedding frequency increased the organizations in the cavities between cylinders. Heat transfer increases of up to 12% were measured on the front of the middle cylinder for small spacings and frequencies near the natural frequency.

11985 (CONF-8510176—, pp 248-255) **Effect of sound on vortex shedding from cylinders.** Blevins, R.D. (GA Technologies Inc., San Diego, CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The influence of a transverse sound wave on vortex shedding from a rigid circular cylinder has been explored at Reynolds numbers from 20,000 to 40,000. in the absence of sound, the vortex shedding is found to consist of strings of coherent cyclic events which have frequencies that wander randomly about the nominal vortex shedding frequency. Application of sound at the vortex shedding frequency eliminates this wander and correlates the shedding along the cylinder axis. The frequency of vortex shedding can be shifted by sound applied either above or below the nominal vortex shedding frequency. This entrainment is produced by the velocity induced by the sound wave rather than by the sound pressure. These phenomena are also observed in tube rows.

11986 (CONF-8510176—, pp 256-265) **Heat transfer to impinging air jets.** Goldstein, R.J. (Univ. of Minnesota, Minneapolis). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

Two studies on heat transfer to impinging air jets are described. The first is conducted with a normal (to the heat transfer surface) jet at relatively high Reynolds numbers; the results indicate the importance of the recovery factor of the jet at the plate surface and the potential energy separation in the curved flow at the edge of the jet. The second study considers relatively low Reynolds numbers flow utilizing a special measurement system with a liquid crystal; the influence of oblique angle of the jet to the heat transfer surface is examined. Heat transfer correlations are obtained in both studies.

11987 (CONF-8606245—1) **Computational fluid dynamics for multiphase flow systems.** Sha, W.T. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001559.

From Society for Industrial and Applied Mathematics workshop on multiphase flow; Leesburg, VA, USA (2 Jun 1986).

The objective of this paper is to identify research and development areas that are urgently needed in computational fluid dynamics of multiphase flow.

11988 (DOE/ER/13528—1) **Subcooled sprays in a vapor environment: Tests of the two-fluid model for two-phase flow: Progress report for period May 15, 1986 to December 31, 1986.** Wallis, G.B.; Richter, H.J. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Jan 1987. Contract FG02-86ER13528. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003855.

The FLUENT code has been adapted to model condensation and provide predictions of velocity and temperature distributions of both liquid and vapor phases. The PHOENICS code has been installed. A small pressure vessel has been built for basic phenomenological experiments and to test instrumentation. The potential of Laser-Doppler techniques has been investigated and tests are planned.

11989 (ESA-TT—29) **Highly underexpanded exhaust plume from nozzles with boundary layer.** Naumann, K.W. (European Space Agency, 75 - Paris (France)). Sep 1985. 114p. (DFVLR-FB—85-10; ETN—86-97573). NTIS, PC A06/MF A01; original German version available from DFVLR, Cologne, West Germany DM 28.

The expansion of underexpanded free jets from a conical hypersonic nozzle is analyzed for Reynolds numbers typical of satellite attitude control thrusters. The laminar nozzle boundary layer is measured. Streamlines in the free jet and the flow conditions inside the barrel shock are determined. Comparison with the Simons continuum plume model shows discrepancies proceeding from rarefaction effects in the Prandtl-Meyer expansion originating at the nozzle lip (freezing of the expansion curvature). The suitable formulation of a freezing parameter allows the fixing of the frozen streamline directions and flow conditions in the free jet expansion even for the streamlines originating from the nozzle boundary layer. Approximated free jet configurations show good agreement with experiments.

11990 (FEI—1636) **Effective properties of heterogeneous media with elastically fixed inclusions in vibrational effects.** Fedotovskij, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700446.

Dynamic behaviour of heterogeneous media formed with incompressible liquid and elastically fixed inclusions contained in it under vibration conditions affected liquid is considered. Effective inertial and viscous properties of such heterogeneous media are introduced and their time dispersion characteristics are studied. Analysis of effective properties in low-frequency, high-frequency and resonance vibrational effects is given, limiting ratios for heterogeneous media with free and fixed inclusions have been obtained. Effective inertial and viscous properties of heterogeneous media are shown to have close analogy to permittivity. As an example of the theory application the ratios obtained were used for calculating eigenfrequencies of body oscillations with a cavity filled with heterogeneous medium serving as the simplest model of fuel assembly. 10 refs.; 2 figs.

11991 (FEI—1642) **Results of investigation of spray controlled heat transfer crisis in tubes.** Sapankevich, A.P.; Kalinina, O.K.; Selivanov, Yu.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700447.

Coefficient of liquid phase mass transfer is a determining parameter in tubes at crisis controlled with precipitating on heat surface a liquid phase carried in flow. To determine mass transfer coefficients in 4-14 MPa pressure range at 400-2000 kg/m^{2}s mass velocities, special experiments were performed in experimental section consisting of two independently heated tubes in-series-connected along the flow. Heat transfer crisis was reached simultaneously in two sections which permitted to eliminate influence of liquid flowing on the wall in the controlsection. A part of heat removed due to forced convection was taken account of during calculation of mass transfer coefficient. Processing results are presented in the criterional form. Mean-square deviation with respect to massive ob-

tained was amounted to 24% during calculation of the mass transfer coefficient and 20% during calculation of critical heat flux. 8 refs.

11992 **(LA—10854-MS) A predictor-corrector method for calculation of incompressible fluid flow dynamics.** Kashiwa, B.A. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003804.

A new method for solution of the time-dependent, incompressible fluid conservation equations is presented. The method is distinguished from other computational techniques for incompressible flows by its use of the same control volume for mass and momentum, rather than mass and momentum control volumes that are staggered in space. Employing coincident control volumes for mass and momentum makes the velocity and pressure appear as cell-centered variables. The use of a cell-centered velocity and pressure is made possible by use of a predictor-corrector formulation that is implicit in the pressure term in both predictor and corrector phases of the computation. The particular predictor-corrector technique presented here is modeled after the method introduced by MacCormack for compressible flows. Hence, the scheme is second-order accurate in both space and time, and can be used on a computational grid of arbitrary polygons. In multiphase flow computations use of coincident control volumes for both mass and momentum means thath the velocity can be defined as the ratio of momentum per unit volume to mass per unit volume, in a consistent fashion. 12 refs., 8 figs.

11993 **Two-fluid model simulation of density-wave oscillations in a boiling flow system.** Dykhuizen, R.C.; Roy, R.P.; Kaira, S.P. (Sandia National Labs., Fluid and Thermal Sciences Dept., Albuquerque, NM). *Nuclear Science and Engineering;* **94**: No. 2, 167-179(Oct 1986).

A direct simulation of the density-wave oscillation limit cycle in a boiling flow system has been carried out. An unequal velocity, unequal temperature two-fluid description of boiling flow was used. The simulation procedure is aided considerably by first performing a linear stability analysis of the system in time domain. Comparison with experimental data is reported.

11994 **Prediction of friction and heat transfer for viscoelastic fluids in turbulent pipe flow.** Hartnett, J.P.; Kwack, E.Y. (Univ. of Illinios, Chicago, IL). *International Journal of Thermophysics;* **7**: No. 1, 53-63(Jan 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

Experimental measurements of the friction factor and the dimensionless heattransfer j-factor were carried out for the turbulent pipe flow of viscoelastic aqueous solutions of polyacrylamide. The studies covered a wide range of variables including polymer concentration, polymer and solvent chemistry, pipe diameter, and flow rate. Degradation effects were also studied. It is concluded that the friction factor and the dimensionless heat transfer are functions only of the Reynolds number, the Weissenberg number, and the dimensionless distance, provided that the rheology of the flowing fluid is used.

11995 **The effect of rarefaction on impact pressure measurements in supersonic flows.** Fisher, S.S. (Univ. of Virginia, Charlottesville, VA). pp 461-468 of Rarefied gas dynamics-Vol. 1. Belotserkovskii, O.M.; Kogan M.N.; Kutateladze, S.S.; Rebrov, A.K. New York, NY; Plenum Press (1985). (CONF-820742—).

From 13. international symposium on rarefied gas dynamics; Novosibirsk, USSR (5 Jul 1982).

Some available experimental data are reviewed for the ratio p/sub i/ of measured-to-ideal impact pressure for long, circular-section approximately adiabatic impact probes immersed at zero angle of attack in supersonic flows are reviewed. The type of impact probe of interest is shown; it is an open-ended, circular-section tube having some effective internal length. Some expected behaviors for other probe flow conditions are presented.

11996 **Particle-dynamics calculations of shear flow.** Walton, O.R. (Lawrence Livermore National Lab., CA). pp 327-338 of Mechanics of granular materials: new models and constitutive relations. Jenkins, J.T.; Satake, M. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (1983). Contract W-7405-ENG-48.

Two-dimensional discrete particle computer models similar to those of P. Cundall are described. The soft-particle approach used in these models allows them to be applied over a wide range of conditions from static situations through rapid shear conditions. Surface friction between particles and with boundary walls is explicitly modeled. Particular attention is paid to the modeling of dynamic situations wherein the energy losses and momentum transfer during inter-particulate collisions play important roles. Comparisons with analytic solutions have verified the numerical techniques and direct comparison with physical tests involving several particles have verified the models ability to calculate the motion of real materials. Direct shear tests on oil shale rubble and corresponding calculations indicate qualitatively similar circulation phenomena and both showed large fluctuations in the magnitude of the shearing force. Incline chute flow calculations are providing detailed descriptions of individual particle paths in which shearing and size segregation phenomena can be observed. Initial comparisons with experiments indicate somewhat slower segregation in two-dimensional calculations than in experiments with spherical particles. 18 references, 5 figures, 1 table.

4205 Materials Testing

REFER ALSO TO CITATION(S) 11245, 11617, 11636, 13008

11997 **(CONF-860856—11) Ultrasonic NDE of green-state ceramic using focused through-transmission.** Roberts, R.A. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001494.

From Conference on review of progress in quantitative NDE; San Diego, CA, USA (3 Aug 1986).

The use of focused ultrasound fields in conjunction with the vacuum-coupled film encapsulating technique provides an effective means for the detection of isolated inclusions and localized inhomogeneities in green-state ceramic materials. Inclusions in the 100 μm to 1000 μm dia range have been successfully imaged in 0.25 in. thick green-state specimens. Likewise, localized nonuniformities in compaction density can be effectively imaged. The integration of such techniques into ceramic processing prior to densification could have a significant impact on both product cost and reliability.

11998 **(DOE/ER/13484—T1) Effects of crack geometry and material behavior on scattering by cracks for QNDE [quantitative non-destructive evaluation] applications: Technical progress report, March 1, 1986-February 28, 1987.** Achenbach, J.D. (Northwestern Univ., Evanston, IL (USA). Technological Inst.). 19 Dec 1986. Contract FG02-86ER13484. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003874.

Among the methods of quantitative non-destructive evaluation (QNDE) of structural elements, the method based on scattering of ultrasonic (elastic) waves by flaws is particularly useful. Since March 1986, new results have been obtained in three problem areas, all three directly related to the detection and characterization (by ultrasonic methods) of single flaws or distributions of flaws. This paper briefly reviews these recent results.

11999 **(DPST—86-637) Radiographic image enhancement.** Hayes, D.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). May 1986. Contract AC09-76SR00001. 3p. (CONF-8605212—1). NTIS, PC A02. File Number DE87002655.

From 47. DAMSUL committee meeting; Miamisburg, OH, USA (13 May 1986).

Radiography is the nondestructive test method used in the Tritium Production Facilities to verify the integrity of confined pinch tube welds. A digital image processing system is being developed to enhance the radiographic image for quantitative and quali-

tative analyses. Improved measurements accuracy, repeatability, and detail definition will be obtained through its use. The development program is the joint effort of the Du Pont Engineering Department and the Savannah River Tritium Facilities technical support studies group.

12000 **(EGG-M—11186) Ultrasonic detection of weld bead geometry.** Carlson, N.M.; Johnson, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 8p. (CONF-860856—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87000441.

From Conference on review of progress in quantitative NDE; San Diego, CA, USA (3 Aug 1986).

The three basic components needed to truly automate a welding machine are being investigated in a joint research effort involving the Idaho National Engineering Laboratory (INEL) and the Massachusetts Institute of Technology (MIT). These are: sensors to detect the physical properties of the weld, a model of the welding process, and a control system that can take signals from the sensors, for use in the feedback control, to the welder. Research programs at the INEL are developing electro-optic and ultrasonic sensors to detect the physical properties of the weld and a model of the welding process to relate these properties to parameters in the control model being developed at MIT. This paper discusses the ultrasonic sensing techniques which detect weld bead geometry on root passes during the gas metal arc (GMA) welding process and the approach for acquiring and evaluating the ultrasonic signal and assessing its quality for use as an input signal to a closed loop controlled welding system.

12001 **(ORNL/TM—10106) Ultrasonic examination techniques for multicouple thermoelectric subcomponents and assemblies: Status report.** Cook, K.V.; McClung, R.W.; Simpson, W.A. Jr.; Cunningham, R.A. Jr. (Oak Ridge National Lab., TN (USA)). Sep 1986. 47p. NTIS, PC A03/MF A01. File Number DE87004026.

Since the early 1960s, the United States has been using radioisotope thermoelectric generators (RTGs), developed by the US Department of Energy and its predecessors, for a variety of environments including space. A recent concept in building RTGs uses modular components to allow for an advanced, lighter space mission generator that provides scaled power level outputs. The scalability feature of the modular isotopic thermoelectric generator (MITG) represents a major advance over earlier RTG designs. However, special problems are encountered in applying nondestructive testing methods because of the miniature size of parts that require inspection. This report describes the status of ultrasonic inspection methods being developed to examine the subcomponents and assemblies of the; MITG. The principal emphasis has been to evaluate various bonds between subcomponents using ultrasonic techniques that employ focused search units and a pulse-echo method.

12002 **(SAND—86-2623C) SNLA's [Sandia National Laboratories at Albuquerque] high precision ultrasonic scanning system and synthetic-aperature-focusing technique.** Shurtleff, W.W. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 11p. (CONF-861195—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002482.

From 29. meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO); Amarillo, TX, USA (18 Nov 1986).

The NDT divisions at SNLA are continually striving to anticipate customer requests by adding advanced test facilities. This paper describes a new ultrasonic testing system being developed in Albuquerque to provide precise scanning of smaller test objects. There are two major subsystems that make up the ultrasonic testing system, a high precision scanner/digitizer and a real-time processing system which automates the synthetic aperture focusing technique. These subsystems are described in the following sections.

12003 **(UCRL—94737) Sum frequency generation of 254 nm light and its application as a diagnostic for supersonic vapor streams.** Combs, R.L.; Chiba, Z.; Wooldridge, J.; Hill, R.; Chen, H.L. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 25p. (CONF-861177—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003253.

From 9. international conference on lasers and applications; Orlando, FL, USA (3 Nov 1986).

We describe a technique for generating a narrow linewidth, tuneable, continuous wave, ultraviolet diagnostic beam. The technique utilizes a sum frequency generation technique in which 657 nm and 413 nm light is combined in KDP to generate up to 0.1 mW of uv light. Results of the use of this diagnostic beam to determine vapor properties of a supersonic stream of mercy vapor will be presented. We will also describe the general technique for generation of other wavelengths from 236 to 274 nm.

12004 **Piezoelectric measurements on ceramic multilayer capacitors.** Suchicital, C.T.A.; Payne, D.A. (Univ. of Illinois, Urbana). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Components, Hybrids, and Manufacturing Technology;* **CHMT-8**: No. 2, 283-288(Jun 1985). Contract AC02-76ER01198.

Piezoelectric measurements are reported for a series of commercial multilayer capacitors which had been previously tested and sold for high-reliability applications. The capacitors conformed to BX specifications and were fabricated from various combinations of barium titanate based dielectric compositions with different electrode materials. Dielectric properties are reported, including distributions in capacitance values and variations in Curie-Weiss behavior. Piezoelectric measurements were made of the d_{13} and d_{33} coefficients; and data are reported for their distribution in values, and temperature and voltage dependencies. Significant piezoelectric coefficients were detected for capacitors in their as-received conditions. In certain cases the piezoelectric coefficients approached 1000 pC/N. The results are discussed in the context of what effects life-testing conditions may have on dielectric quality. Experiments are also reported for the electric-poling and thermal-depoling of multilayer ceramic capacitors. Concern is expressed for the over-testing of thin layer ceramic devices. Calculations indicate the strain deformation can exceed the elastic limit in certain conditions, resulting in mechanical failure. In addition, the generation of electric charge or potential by mechanical vibration contributes a significant noise to circuit applications. Voltage levels were in the millivoltage range. The study indicates that significant problems may arise in commercial ceramic multilayer capacitors due to a generally unrecognized piezoelectric effect. 5 references, 9 figures, 5 tables.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 11718, 11921, 11949, 12228, 12935

12005 **(EPRI-NP—4769-SR, pp 1.73-1.86) Sensitivity of a micro-processor based controls system to variation in fault-tolerant parameters.** Erickson, R.A. (Boeing Computer Service, Tukwila, WA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

Advanced microprocessor control systems have the potential for providing high reliability and low maintainability costs through the use of a shared processing resource based upon generic microprocessor units. Studies have shown that by providing high reconfigurability and pooled spares, reliable systems can be constructed using fewer components and component types than past designs. However, these new systems depend upon fault detection and identification capabilities far beyond those experienced by mature systems. This study demonstrates the criticality of correct fault identification crucial to the reliability of advanced microprocessor control systems. In the current study, a candidate avionics control system data processor design was analyzed to determine the sensitivity of system reliability to the frequency of non-permanent faults

and the ability to correctly identify them. It was found that small changes in the probability of correct fault identification has a severe impact upon system reliability which cannot be easily accommodated by increasing the number of pooled spares. Thus, viability of an avionics system based upon a common data processor is dependent upon the ability to discriminate between permanent and non-permanent faults.

12006 (EPRI-NP—4769-SR, pp 1.89-1.119) **Evaluation and validation of fault-tolerant digital control systems.** Schabowsky, R.S. Jr.; Weinstein, W.W. (Charles Stark Draper Lab., Cambridge, MA). Sep 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920044. (CONF-8604269—).

From Seminar on power plant digital control and fault-tolerant microcomputers; Scottsdale, AZ, USA (9 Apr 1986).

A broadbrush examination of the concepts, methodologies and issues related to the practical use of Markov reliability models is presented. Guidelines are provided for a design and evaluation methodology which realizes robust fault-tolerant systems.

12007 **(SLAC-PUB—4109) FASTBUS dual-port memory and display diagnostic module.** Bertolucci, B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1986. Contract AC03-76SF00515. 5p. (CONF-861007—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002846.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

A dual-port FASTBUS memory module has been designed as a diagnostic tool for both Crate and Cable segments. This report contains schematic diagrams of both receiver and display circuits and a block diagram of the devices operational logic. (DWL)

12008 **(UCRL—95668) Nonlinear coupling of high-power microwaves in apertures.** Yee, J.H.; Sieger, G.S.; Mayhall, D.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 23p. (CONF-861240—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003255.

From 3. national conference on high power microwave technology for defense applications; Albuquerque, NM, USA (1 Dec 1986).

We used numerical calculations to determine the effects of air breakdown on the coupling of intense microwave pulses passing through apertures. Our calculations are based on a set of Maxwell equations and electron-fluid equations. Results show that the air-breakdown threshold energies in apertures have a functional dependency on pressures similar to that of air-breakdown threshold energies in the atmosphere. We present variations of the transmitted energies of intense microwave pulses passing through apertures as a function of incident-field intensity and aperture size. The effects of secondary emission on the air-breakdown threshold energies around apertures are also discussed.

12009 **(UCRL—95734) EM laboratories for linear coupling.** King, R.J. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 8p. (CONF-861240—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002584.

From 3. national conference on high power microwave technology for defense applications; Albuquerque, NM, USA (1 Dec 1986).

Broadband, well calibrated, sensitive, and automated laboratories are essential for conducting meaningful phenomenology and susceptibility characterization studies. This presentation gives an overview of the following issues, reflecting the facilities and experiences at Lawrence Livermore National Laboratory.

12010 **Electronic logic to enhance switch reliability in detecting openings and closures of redundant switches.** Cooper, J.A. (to Dept. of Energy, Washington, DC). US Patent 4,626,708. 2 Dec 1986. Filed date 20 Jan 1984. v.p.

A system is described for enhancing switch reliability comprising: first and second switches, each having open and closed output states; memory means operatively connected to first and second switches for storing the last common output state simultaneously held by both the switches; and logic means responsive to the memory means and the first and second switches for generating a first system output when both the switches are closed or when one of the switches closes when the last common output was open. A second system output is generated when both the switches are open or when one of the switches opens when the last common output was closed.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 10830, 11016, 11578, 11989

12011 **(CONF-861211—19) Theoretical analysis of heat transfer due to particle impact.** Sun, J.; Chen, M.M. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1986. Contract FG22-85PC80511. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000862.

From American Society of Mechanical Engineers winter meeting; Anaheim, CA, USA (7 Dec 1986).

The heat exchange between impacting spherical particles or a particle and a surface is analyzed. The purpose of the study is to obtain quantitative understanding of the direct conductive contribution of particles in suspension flows and fluidized beds. The change of the contact area with time is determined from classical elastic theory. The heat exchange for each impact of particles is expressed by a simple one-dimensional heat conduction solution multiplied by a correction factor. The factor is calculated numerically for most of the solid materials. By comparing experimental measurements from a fluidized bed, the solution verifies that for particles with low thermal conductivity, the conduction effect is not an important mechanism for the total heat transfer process, but when the particle has high thermal conductivity or the surrounding gas has low conductivity, the conduction heat transfer may become important. 7 refs., 5 figs.

12012 **(DOE/AL/31881—1) Investigation of the characteristics of liquid fuel burning, Rijke type, pulsating combustors, Annual report.** Zinn, B.T.; Daniel, B.R.; Katz, U.; Xu, T.S.; Su, A. (Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering). Nov 1986. Contract AS04-85AL31881. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001931.

This report describes the results obtained during the first year of a DOE sponsored research program entitled "Investigation of the Characteristics of Liquid Fuel Burning, Rijke Type, Pulse Combustors". This research has been concerned with the development of an efficient, nonpolluting, pulse combustor which burns liquid fuels. The design of the developed combustor is based upon principles of the acoustic Rijke tube which had been previously used, by the principal investigators of this study, to guide the development of a highly efficient, coal burning pulse combustor. The present study was initiated with the objective of determining whether the high performance achieved with the coal burning pulse combustor can be duplicated with the liquid fuel burning, Rijke type, pulse combustors. This document also describes the development of the experimental set-up and its subsequent modifications which resulted in improved performance. These studies revealed that pulse combustion operation can be maintained by more than one mechanism.

12013 **(N—86-31654) SSME main combustion chamber and nozzle flowfield analysis. Final Report.** Farmer, R.C.; Wang, T.S.; Smith, S.D.; Prozan, R.J. (Continuum, Inc., Huntsville, AL (USA)). Mar 1986. 43p. (NASA-CR—178893; NAS—1.26:178893; CI-FR—0085). NTIS, PC A03/MF A01.

An investigation is presented of the computational fluid dynamics (CFD) tools which would accurately analyze main combustion chamber and nozzle flow. The importance of combustion phenomena and local variations in mixture ratio are fully appreciated; however, the computational aspects of the gas dynamics involved were the sole issues addressed. The CFD analyses made are first compared with conventional nozzle analyses to determine the accuracy for steady flows, and then transient analyses are discussed.

12014 **(BG-Trans—15026) Development of low-noise combustion intensity burners (III).** Tabata, A.; Kuwabara, S.; Yamasawa, Y.; Shigeta, E. (British Gas Corp., London; Tokyo Gas Research and Development Inst. (Japan)). [1986]. Translated from 30th annual technical report of the Tokyo Gas Research and Development Institute, pp 81-95. 27p. NTIS (US Sales Only), MF A01. File Number DE87900427.

The development and practical application of pulse combustors has so far been hampered by generation of high-level combustion noises and by the fact that the theory involved in their operation is very complicated. Pulse combustion has, however, attracted considerable attention as a new heating method because of its high combustion intensity and excellent heat transfer rate. The present study is devoted to the development of the so-called flip-flop combustor which utilizes the principle of pulse combustion. During the current year, we have been conducting various studies on the structure of the grid which plays a decisive role in the combustion unit of flip-flop combustors and have succeeded in establishing its optimum dimensions. In addition, we also determined the optimum shape of the streaming portion of the combustion chamber which is of importance for the combustion stability of valveless pulse combustors.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 10848, 10849, 11932, 11933

12015 **(DTH-ISVA—39) Interaction between a pipeline and an erodible bed.** Mao Ye. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). Mar 1986. 177p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87750593.

The interaction between a pipeline and an erodible bed has been studied. The two-dimensional scour under a fixed pipe in current is studied. First, the on-set of the scour in the case when a fixed pipe is resting on a plane bed has been studied. Then based on a modified potential flow theory, a mathematical model on the scour underneath pipelines has been proposed. A simplified physical model on the three-dimensional scour in a current has been proposed. The scour depth is slightly deeper than that in the fixed-pipe case. A formula to estimate the maximum length of the span is proposed, and a numerical example is given. The role of the vortex shedding in the scour below pipelines has been investigated. A simple model has been developed to predict the vortex-induced near-bed velocity. The scour under pipelines exposed to two-directional flow is studied. In the presence of the sand waves, the pipe fixes the trough of the sand waves in its neighbourhood. The wake-induced erosion plays a significant role in the two-directional-flow case. The scour depth is deeper than that in the current case. In the high sediment transport stage, the scour depth under the pipe may be several times the pipe diameter. The scour depth in the sagging case is shallower due to the shelter of the upstream hill and the sinking of the pipe in the scour hole. The interaction between the pipe vibration and an erodible bed is investigated. The influence of the pipe vibration on the scour below the pipe is studied. The water body in the scour hole gives resistance to the pipe vibration. The pipe state with respect to the pipe vibration can be classified into three stages: the pre-vibration stage, the lock-in stage and the lock-out stage. The eroded bed has strong restrictive action on the pipe vibration. The problems in the two-directional flow and in the sagged-pipe case have been studied too. (EG).

12016 **(ETN—6-97374) Damping force exerted by a viscous medium upon an oscillating cylinder.** Meijssen, T.E.M. (Technische Hogeschool Twente, Enschede (Netherlands)). Jul 1984. 73p. (In Dutch). NTIS, PC A04/MF A01.

The damping force which an unlimited, homogenous, incompressible, and viscous medium of certain density and kinematic viscosity exerts on an oscillating, infinitely long, stiff, circular cylinder was determined for offshore purposes. The oscillation amplitude is supposed much smaller than the cylinder radius. Three fields, characterized by order magnitudes of the so-called flow Reynolds number Rs, were distinguished: Rs much less than 1, Rs = 0(1), and Rs much greater than 1. Solutions for the related flow functions and corresponding expressions for the damping force are discussed.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 10761, 11180

12017 **(CEGB-TPRD-L—2932-N85) Review of the literature on pulse energization for electrostatic precipitators.** Corbin, R.G. (Central Electricity Research Labs., Leatherhead (UK)). Feb 1986. 29p. Central Electricity Research Lab., Leatherhead, England.

This report reviews literature to investigate claims that commercial pulse energization systems, for retro-fitting electrostatic precipitators can improve efficiency by increasing the electric field particle charge, and reduce back discharge problems with a highly resistive dust. Reports that migration velocity has been improved up to three times its unpulsed value, although the optimum pulse conditions, duration and repetition rate have not yet been established. It concludes that too few results from full scale tests are available to assess the prospects for pulse energisation.

4250 Power Cycles

REFER ALSO TO CITATION(S) 11585

12018 **(EPRI-AP—4826) Screening evaluation of advanced power cycles: Final report.** Dawkins, R.P.; Jacob, J.T.; Rao, A.D.; Bharvani, R.R. (Fluor Technology, Inc., Irvine, CA (USA)). Nov 1986. 246p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920097.

This report presents the results of a study of nine prospective power cycles that initially promised coal to busbar efficiencies of 40% or higher. The study was conducted for EPRI by Fluor Technology, Inc. with the participation of the General Electric Co., Westinghouse Electric Co., and Energy Research Corporation. The intent of this study is to evaluate the potential for further development of these new power cycles incorporated within a gasification-combined-cycle power plant. Therefore, all but one of the power cycles are based on the use of clean fuel gas produced by an oxygen-blown coal gasification system. The exception is a magneto-hydrodynamic (MHD) steam cycle evaluated in a direct coal-fired mode. However, a second MHD case is included which is coupled to a coal gasification system. Based on the methodology and criteria used in this study, it appears that, unless new and promising concepts come forth, the Advanced Temperature Non-Reheat Combustion Turbine system should receive the most research and development attention. This conclusion applies only to the types of fired fuel used in this study; i.e., gas from coal using Texaco gasifiers for all cycles from Case 1 through Case 8A, and direct coal-fired MHD systems. It is expected that work will continue by EPRI and others in developing molten carbonate and solid oxide fuel cells for applications using fuels other than gas from coal. Since uniquely high efficiencies are available even when these cells are fired with gas from coal, these developments should be monitored to determine if integration of these cells and coal gasification at any future time might be feasible. 42 figs., 58 tabs.

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 12314

12019 **(INIS-SU—369) Proceedings of the 9. All-union confernece on charged particle accelerators. Vol. 2.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Joint Inst. for Nuclear Research, Dubna (USSR); AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. 449p. (In Russian). (CONF-8410203—Vol.2). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052.

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The individual papers in this meeting have been abstracted separately.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 12141, 12159, 12690, 12954, 12966

12020 **(CTA-IEAV-NT—04/85) General aspects of installations for Paje accelerator.** Goncalez, O.L.; Yanagihara, L.S. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 11 Apr 1985. 27p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700452.

It is done the preliminary proposal for a 180 MeV/50 Kw linear electron accelerator facility, to be used as a pulsed neutron source. Some technical and economic aspects of this facility in the Instituto de Estudos Avancados' accelerator technology program are discussed.

12021 (INIS-SU—352, pp 384-387) **Measuring dc converters for the power supplies of electro-physical installation magnet elements.** Denisov, Yu.N.; Kalinichenko, V.V.; Savaneev, V.P. 1985. (In Russian). NTIS (US Sales Only), PC A20/MF A01. File Number DE87780023. (CONF-8410203—Vol.1).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Three versions of direct current measuring converter (DCMC) for the power supplies of charged particle accelerators are described. The first DCMC represents a closed-loop servo system. It consists of a magnet modulator, demodulator, unipolar pulse generator, direct current (dc) amplifier control unit, low - pass filter and standard resistor. The converter unit for 0-200 A currents has an instability not exceeding +- 3 mA x loop for 8 hours of operation. The secondDCMC is constructed using the dc transformer. It comprises two magnetic circuits, each of which has inducing windings. Compensation winding sections, biasing winding and measuringwinding realized as one loop are common for both magnetic circuits. The third DCMC is realized on the base of the secondand magnetic modulator with doubling frequency. The instability of such DCMC does not exceed +-1 mA x loop for8 hof operation.

12022 (INIS-SU—369, pp 20-24) **Relativistic nuclear beam production for physical experiments on the JINR synchrotron.** Vasilishin, B.V.; Volkov, V.I.; Zinov'ev, L.P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A status of the JINR synchrophasotron is described in connection with its use for acceleration of nuclei. Main parameters of synchrophasotron and beam intensities are given. Layout diagram of beam transport channels and experimental facilities is shown. Experiments on particle extraction with approximately 0.5 s duration were performed and characteristics of the second slow extraction are presented. In 1984 experiments on proton beam extraction from the accelerator chamber by means of a monocrystal were conducted. Experiments with polarized deuteron beams are envisaged in future.

12023 (INIS-SU—369, pp 53-56) **Design parameters of the Erevan synchrotron modernization for production of continuous extracted beams of electrons and photons till 6 GeV.** Vasil'ev, A.A.; Amatuni, A.Ts.; Karabekov, I.P.; Tsakanov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Erevanskij Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of studying possible modernization direction of the Erevan synchrotron permitting to produce electron and gamma quanta beams with temporary filling close to 100% in 2-6 GeV energy range at an average current equal to several μA are given. Synchrotron modernization includes its additional equipment with a stretcher ring. Astretcher ring diagram and its basic parameters are presented. At 1 MW power of HF system and the number of orbit particles of $3x10^{12}$ the stretcher in the accumulation mode will be one of the most intense sources of synchrotron radiation with 1.30 A characteristic wavelength and the number of beam photons of $5x10^{13}$.

12024 (INIS-SU—369, pp 65-67) **Program of technical modification of the Fakel linear accelerator.** Petrenko, V.V.; Chernoplekov, N.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

In order to improve parameters of accelerated beams the program of technical modification of the "Fakel" linear electron accelerator is developed. It is expected that after the complition of the first stage of the program accelerated beams will be produced with the following parameters: energy at total current loading 90 MeV, and 120-140 MeV at zero current; current in the pulse - 1.5 A and 2 A (at current pulse duration 6.10sup(-6) s and 50 x 10sup(-9) s, respectively); beam divergence is 5 x 10sup(-4) rad; beam diameteris less than 1 cm, acceleration repetition rate is 150 and 100 Hz (at current pulse duration of 6 x 10sup(-6) s and 50 x 10sup(-9)s respectively).

12025 (INIS-SU—369, pp 75-80) **Charged particle accelerators for industry and medicine.** Vakhrushin, Yu.P.; Glukhikh, V.A.; Svin'in, M.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The status accelerators used in different branches of industry and medicine is considered. Modern state and prospects of development of new modifications of linear resonance accelerators, cyclotrons and high-voltage accelerators is shown. In accelerators of new generation considered is the increase of power in a beam, online control system, the improvement of mass-dimentional indices, reliability increase. It is supposed to equipt industry and medicine with new-generation accelerators in the 12th Five-Year Plan.

12026 (INIS-SU—369, pp 86-90) **Cyclic heavy ion implantator for applied purposes.** Flerov, G.N.; Andriyanov, A.M.; Apel', P.Yu. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Nuclear filters are a new type of porous membranes, produced in irradiation of polymer films with accelerated heavy ions with further chemical treatment. Data are presented on selectivity of track etching in lavsan film depending on Zsub(ef)/β ratio where Zsub(ef) - ion charge; β=V/c (V is the ion velocity, c is the light velocity). A possibility of the application of ^{40}Ar ions for production of nuclear filters is shown. Description of separate systems of the JTs-100 isochronnous cyclotron designed for production of beams of heavy ions including argon with the energy of 36 Z^2/A^2 MeV/nucleon is presented. Sup(40)Arsup(+7) ions with 1 MeV/nucleon and 10^{12} ssup(-1) intensity which will be used for production of nuclear filters are main accelerating particles.

12027 (INIS-SU—369, pp 91-93) **Status on the use of cyclotrons in industry and medicine.** Vakhrushin, Yu.P.; Vorogushin, M.F.; Galaev, A.N.; Gal'chuk, A.V.; Davydov, M.S.; Korolev, L.E.; Krymov, E.B.; Malyshev, I.F.; Stepanov, A.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The design of 3 types of cyclotrons (MGTs, DTs and RITs) in the series of 6 types for national economy and medicine is finished. The U-250 cyclotron is under construction. The assembly is finished and tune-up works are in the process at the of the DTs cyclotron prototype designed for deuterium acceleration up to 3 MeV at 100 μA beam current on external target. The equipment is made and works are begun on magnetic field formation and tuning RF accelerating system of the RITs cyclotron. The cyclotron is designed for proton acceleration up to 30 MeV at beat current of 1000-1500 μA at the internal and up to 200 μA on the external targets. The cyclotron is designed for isotope production.

12028 (INIS-SU—369, pp 94-97) **Light ion linear accelerators for applied purposes on the base of structures with spiral half-wave vibrators.** Val'dner, O.A.; Gass, V.F.; Glazkov, A.A. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The status of the development of the unified series of 3 MeV applied purposes linear accelerators of light and semi-heavyions is described. A spiral structure consisting from half-wave vibrators rolled-up into cylindric spirals, is chosen as an accelerating structure. Hydrogen and helium ions are accelerated at the wave length of 2 m and heavy ions at wave lengths of 4 and 8 m. The injection voltage for all accelerators is equal to 10 kV. Particle capture into the accelration mode constitutes 25% energy spread at the half-height is 5%, the critical current in the pulse is 1.5 μA. Main parameters of the beam are presented. Basic units of the prototype of the "Uragan-1" accelerator are constructed.

12029 (INIS-SU—369, pp 98-101) **Pulse power supply of a linear accelerator for nondestructive testing.** Bol'shakov, B.O.; Kavalerchik, L.Z.; Solov'ev, Yu.V.; Fomin, L.P.; Ehrmel', V.Eh. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The LUEhU-10-5000D linear electron accelerator pulse power supply system is described. The accelerator is designed for industrial radiography. A function circuit of the accelerator pulse power supply and parameters of the electrical supply of the grid modulation Klystron are presented. Grid modulator circuit operates on the principle of partial discharge of accumulator. Klystron cathode and electron source have joint power supplying from the UP1 high voltage source. The UP1 is connected in the full-wave rectifier circuit.

12030 (INIS-SU—369, pp 102-105) **U-33 3 cm linear electron accelerator for radiation investigations.** Kuz'min, I.A.; Saverskij, A.Ya.; Shaltyrev, A.P.; Shchedrin, I.S. (Moskovskij Inzhenerno-Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A description and parameters of the U-33 3 cm linear accelerator are presented. Presence of removable accelerating system is the specific feature of the U-33 compared to other accelerators of this type. Besides the 1.2 MeV main accelerating section developed are two other variants: accelerating section with energy tuning from 0.2 to 1.5 MeV and two-sectional system with a supply from one selfoscillator. The accelerator design is two separate units-accelerator table and of CHF supply. Overall dimensions do not exceed 1700x1700x2000 mm. Accelerating section is a circular diafragmatic waveguide ofthe length of about 750 mm. Accelerator is are proposed to be used in the room with biological shield made of concrete with wall thickness more than 0.5 m.

12031 (INIS-SU—369, pp 114-117) **Heavy particle high-frequency accelerator on the base of selfoscillator with power capacitive coupling.** Panasyuk, V.S.; Samoshenkov, Yu.K.; Simanovskij, M.F.; Filimonov, V.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Optiko-Fizicheskikh Izmerenij, Moscow, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A capacitive coupling of anode circuits of accelerating structure tube is called a "force" one with the aim to differ it from feedback circuit in selfoscillators. A small-sized proton accelerator has been developed and put into operation to investigate the properties of the force capacitive coupling. Anode of the tube at capacitive coupling is connected directly to the coupling capacitance. The use of forced capacitive coupling permitted construction of a rather small-sized simple and reliable in operation accelerator. In the process of accelerator tuning the following parameters have been achieved: proton energy 1 MeV, pulse current 5 mA. An accelerating station of a synchrotron can be constructed using similar scheme.

12032 (INIS-SU—369, pp 123-125) **Development and investigation of DIN-1 and LNT-2M accelerating neutron tubes for national economy.** Bespalov, D.F.; Vojtenko, V.A.; Gul'ko, V.M.; Kolomiets, N.F.; Pleshakova, R.P.; Ryabov, E.V.; Tsybin, A.S.; Shikanov, A.E. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of development and investigation of the DIN-1 and the LNT-2M accelerating neutron tubes for national economy are presented. At pulse accelerating voltage amplitude of 150 kV and at frequency of 20 Hz the DIN-1 tube permits neutron fluxes with 15 MeV energy up to 10^9 n/s, its lifetime reaching 60 hours in this case. The tube diameter is 60 mm and its length is 300 mm. The LNT-2M laser neutron tube at accelerating voltage of 130 kV and frequency of 25 Hz permits neutron fluxes with 14 MeV energy up to 10^{10} n/s. This tube lifetime can reach 20 hours. External diameter of the tube is 60 mm, length - 250 mm.

12033 (INIS-SU—369, pp 118-122) **High-current nanosecond electron accelerators with high pulse repetition rate.** El'chaninov, A.S.; Zagulov, F.Ya.; Korovin, S.D.; Kutenkov, O.P.; Landl', V.F.; Mesyats, G.A.; Shpak, V.G. (AN SSSR, Tomsk. Inst. Sil'notochnoj Ehlektroniki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Work on construction of high-current manosecond electron accelerators with energy in a pulse of $1\text{-}10^3$ J, electron energy of 0.1-2 MV and pulse repitition frequency up to 400 Hz are carried out in the ISEh SO AN SSSR. Test results of a charging device of shaping line, peaking spark gap, vacuum diode are presented. The lifetime characteristics for cathodes are also given. It is shown that a cathode with incomplete break-down plasma emission from the ceramics surface has the best characteristics. A basic circuit of accelerators is presented. Designs of vaccum diodes are shown.

12034 (INIS-SU—369, pp 126-128) **Microtrons for scientific investigations and applied purposes.** Alekseev, I.V.; Vladimirov, N.V.; Balaev, A.Yu.; Gorbachev, V.P.; Smirnov, P.F.; Solov'ev, A.V.; Stepanchuk, V.P. (Saratovskij Gosudarstvennyj Univ., USSR. Nauchno-Issledovatel'skij Inst. Mekhaniki i Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of the 3 cm-microtrons investigations are presented. It is shown that in the 10 cm microtron the accelerating current at similar density of emission current is one order higher. The 20

MeV microtron is developed and in the process of production, on the basis of the results of investigation. The microtron is designed for analysis of element composition of copper components in nickel electrodes ofchemical current sources. Investigation results of platinotronoperation in the self oscillator mode in the positive coupling circuit, which is the microtron accelerating resonator, are presented.

12035 (INIS-SU—369, pp 129-133) **NIIYaF MGU cutted continuous action microtron.** Gorbatov, Yu.I.; Grishin, V.K.; Ishkhanov, B.S. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of development of the 100 MeV cutted continuous action microtron with beam current of 100 μA and emittence of 0.05π x mm x mrad are presented. Main parameters of microtron are given. The accelerating system comprises a linear accelerator in the injection system and a linear accelerator positioned between bending magnets. The phase motion of electrons has been calculated using the "PHASE" program. The design of accelerator optics and analysis of transverse motion are carried out using the "TRANSPORT", "TURTLE" and "MAGNET" programs. The full lengths of a transport channel at the distance between magnets of 6 m and 25 orbits constitutes 180 m.

12036 (INIS-SU—369, pp 138-142) **Development of unified series of resonance electron linacs for industry and medicine.** Vakhrushin, Yu.P.; Glukhikh, V.A.; Nikolaev, V.M. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A state of technical design of the unified series of linear accelerators for industry and medicine is described. The series includes three types of linear accelerators: for radiation defectoscopy, for radiotherapy for radiation technology, activation analysis and production of short-lived isotopes. LUEhR-20M accelerators are designed for large oncological centers and hospitals. LUEhR-40M accelerators will be installed in the leading oncologic centres. A prototype accelerator-defectoscope-the LUEhV-10 is constructed. The LUEhR-40M prototype LUEhR-40 M is also made. In accelerators of the unified series the on-line control system with minicomputer is used. A development of industrial tomograph is begun. Specifications of accelerators are presented.

12037 (INIS-SU—369, pp 143-148) **Prototype of an industrial accelerator.** Isakov, I.F.; Logachev, E.I.; Pechenkin, S.A.; Remnev, G.E. (Tomskij Politekhnicheskij Inst., USSR. Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of the development of the 300 keV industrial heavy ion accelerator for modification the surface layer of metals is described. The works were carried out in two directions: tuning of bipulse generator and investigation of heavy ion beam parameters for diode planar geometry. The generation of a power ion beam with the density up to 200 A/cm^2 (for carbon ions) and its interaction with metals are studied in parallel. The accelerator generator is the two single shaping lines and two transmission lines, connected in series. Graphite, magnesium, stainless steel and tungsten were used as material for a potential electrode (PE). It is shown, that mass composition of an ion beam, generated in the regime of direct acceleration from explosive emission plasma under conditions of oilless pumping, is mainly determined by PE material, and the state of its surface. It is concluded that the generation efficiency and energy spectra of ion beams with the given A/z ratio are determined by acceleration rate in anode-cathode gap, and with A/z rise at the given pulse duration of accelerating voltage the spectra shift into low-energy region is observed.

12038 (INIS-SU—369, pp 151-156) **KUTI-20 collective heavy-ion accelerator.** Aleksandrov, V.S.; Antropov, V.K.; Bijskij, S.M. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

20 MeV/nucleon KUTI-20 collective heavy ion accelerator is described. Functionally, the accelerator consists of the SILUND-20 linear induction accelerator, adhezator and the LUEhK-20 linear induction accelerator. SILUND-20 comprises 120 inductors, combined in 5 accelerating sections with 24 inductors in each. The adhezator comprises the following systems: magnetic, power unit with vacuum chamber, electron beam injection, neutral atoms leak-in, vacuum, cooling. LUEhK-20 consists of 10 accelerating sections with 36 inductors in each and interchamber. The main characteristics of the KUTI-20 are given. Investigations on the SILUND output have shown, that emittance of beam current 500 A does not exceed 2.5 mrad x cm (at total current 1000 A). Presently works are conducted on the stabilization of magnetic field with the accuracy 0.1%. Experimental results on the injection of heavy ion atom-jet are presented.

12039 (INIS-SU—369, pp 157-162) **High-current electron accelerators for investigations in the field of relativistic microwave electronics and collective acceleration methods.** Batskikh, G.I.; Kazanskij, L.N.; Kuz'min, A.A.; Meshcherov, R.A.; Oreshin, A.A.; Rybalko, V.S.; Sazhin, V.D.; Seleznev, V.D. (AN SSSR, Moscow. Radiotekhnicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Two megavolt accelerators are described. The first accelerator is used to study and tuning relativistic SHF-generators. The second one is designed for experimental studied of collective acceleration methods. The first accelerator is constructed to conventional circuit. The Arkadiev-Marx generator is envisaged for power supply of magnetically insulated diode. Hallow electron flux is transported by the magnetic field of a sectional solenoid. The accelerator operates with the parameters: 1.2-1.5 MeV, 7-10 kA; magnetic field 2-3 T. In the second accelerator high-voltage pulse generator (HVPG) is constructed on the basis of the "Angara-5" device HVPG module with the power 300 kJ and output voltage 1.5-2 MV. The electron diode has a vertical design. Magnetic field distribution in the diode and dependence of current on cathode position are presented. Presently experiments on the excitation of slow cyclotron and plasma waves in the process of beam interaction with slowing-down structures are conducted.

12040 (INIS-SU—369, pp 401-402) **Electron-positron linear collides. Status of development of a linear accelerator module.** Balakin, V.E.; Bamburov, Yu.G.; Brezhnev, O.N. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

According to the program of the electron-positron linear colliding beams (EPLCB) the development of the linear accelerator module with the acceleration rate of 100 MeV/m is being conducted at the Nuclear physics institute of the USSR Academy of Science (Siberian Departament). Acceleration rate of 55 MeV/m was achieved during the testing of experimental sections with 29 sm length. Electron-optical system modernization of the ELIT-L2 accelerator, used as electron beam sourse in the gyrocon, was conducted. The electron beam energy is increased up to 500 kV. Two accelerating sections, where an accelerated beam with 30 MeV energy has been obtained, are produced now.

12041 (INIS-SU—369, pp 413-420) **Laser acceleration of particles.** Kolomenskij, A.A. (AN SSSR, Moscow. Fizicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Laser methods of charged particle acceleration are considered. Ways of development of laser acceleration of particles are demonstrated - among them the first proposals including autoresonance, quasilinear acceleration and acceleration in the laser field at the expence of the reversed Cherenkov effect. Modern trends in the development of laser acceleration methods are considered. Parameters of two electron accelerators based on the reversed free-electron laser up to 300 GeV energy are presented. Two-beam accelerator, "lattice" accelerator and the particle acceleration in plasma waves, excited by laser beams, are considered.

12042 (INIS-SU—369, pp 421-428) **New generation of electron accelerators for nuclear physics.** Belovintsev, K.A. (AN SSSR, Moscow. Fizicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Parameters of continuous action electron accelerators are presented. Among them only 5 machines operate for the physical experiment. Four of them are recirculators and one is a stretcher. It is shown, that the competition between the "warm" recirculators and stretchers will continue. Such recirculator advantages as high biming stability; small beam emittances; ability to work with beams of different energies; efficiency are demonstrated. The stretcher advantages are: the developed technology of main systems; possibility of experimentson superthin internal targets and of the laser photon Compton scattering on electrons to generate the monochromaticy-quanta; synchrotron radiation application; high energies of >= 5 GeV.

12043 (INIS-SU—369, pp 218-221) **Modified regime of power ion beam production.** Akerman, D.R.; Bystritskij, V.M.; Didenko, A.N.; Volkov, S.N.; Krasik, Ya.E.; Tolopa, A.M. (Tomskij Politekhnicheskij Inst., USSR. Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Experimental results of power electron and ion beams production with a high-voltage pulse generator (HVPG) and correction LC-circuit are presented. Electron beam with the current 2 kA and pulse duration 560 ns in interelectrode gap 60 mm is produced. Integral amplitude of ion beam current at the distance of 25 cm from anode reached 0.6 kA, beam energy at that constituted 40 J. To optimize the beam production method considered numerical simulation of the generator operation with different loadings is carried out. Experimental and numerical studies of beam production made possible: efficient transfer (up to 40%) of HVPG energy into accelerator diode; production of rising voltage on the diode's anode, close to the optimum parabolic one; attaining of ion beam bunching coefficients to an order and higher.

12044 (INIS-SU—369, pp 388-391) **Cryogenic system for an experimental superconducting electron accelerator.** Gurin, S.P.; Ivanov, V.D.; Larionovskij, V.A.; Sokolov, B.A.; Tanchuk, V.N. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The description and the method for calculation of the two-stage ejector-throttling cryogenic system for the experimental superconducting linear electron accelerator (LUES-5) of the 3-5 MeV energy range are presented. Results of experimental investigation of the cryogenic helium ejectors with cylindrical and conical mixing chambers are given. Laval nozzles were used as active nozzles. The designed injection coefficients agree well with those experimentally obtained at ejectors whose structure dimensions were calulated according to the method presented. The (LUES-5) cryogenic system has the following parameters: refrigerating capacity at 1.85-1.9 K-W; the working flow rate for the lower ejector is 2g/sec at 5.25 K; the working flow rate for the upper ejector is 7.8 g/sec at 6 K; the working gas pressure is 2.25 MPa.

12045 (INIS-SU—369, pp 328-331) **Experimental studies of possibilities of shielding high-current accelerator structure elements from destruction by accelerated beam.** Kalashnikov, V.V.; Kapyrin, Yu.V.; Petrenko, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The system and results, determining ultrasound attenuation in high-current accelerator structure elements, are described. It is shown that, when arranging transducers an accelerator structure elements, where accelerating beam impinge is possible, it is necessary to acount the velocity and ultrasound attenuation in the element, as well as the required fast response of the protection system. When protection operation time is approximately 1x10sup(-3) s (if the next electron pulse for the accelerator with frequency of bunches of 1 kHz is turned off) the distance between transducers should be approximately 1-2 m. It is reasonable to construct the system so, that it, firstly, shoul turn off the beam, then should give the information about the place of beam impinge. To determine the place of beam impinge it is quite sufficient to organise in most cases the joint solution of 2 or 3 equations ofx=Vsib(i)Δtsub(i) type, where Vsub(i) is the sound veocity in the structure element with the ith transducer in it, Δtsub(i) is the time of sound propagation recognizing by the ith transducer relatively to the beam triggering moment. The criterion for equation choice is minimum values Δtsub(i). Functions of measurement of beam parameters and fast protection should be separated. Influence of electrical and acoustic noisesis completely excluded due to their time and frequency discrimination.

12046 (INIS-SU—369, pp 8-14) **30 years at the fore front - a perspective on the Bevatron/Bevalac.** Alonso, J.R. 1985. NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The Bevatron/Bevalac 30 years operational experience is described, which can be devided into four major periods: first commissioning and yearly experimental period, when the Bevatron was among the highest-energy machines available (1954-1962): second, a period of (1963-1972): third, the light ion (a less than or equal to 56) period (1974-1981); and finally, the ongoing heavy-ion period. Studies presently in progress shound the possibility of using the Bevatron as an injector to a small storage - ring system called the minicollider, these two superconducting rings can fit quite readily into the existing site with a minimum of impact on present facilities. Factors of particular importance for successfully delivering heavy-ion beams are shown.

12047 **(JINR—R-9-85-567) Superconducting magnet calibration stand. Construction.** Burinov, V.F.; Kukarnikov, S.I.; Lachinov, V.M.; Prejzendorf, V.A.; Sabaev, A.A.; Tishchenko, V.V.; Rubin, N.B.; Kokavec, J.; Cesnak, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods; Slovenska Akademia Vied, Bratislava (Czechoslovakia). Elektrotechnicky Ustav). 1985. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700453.

Submitted to the 3. All-Union conference Methods and ways of measurement of magnetic field parameters, Leningrad, 1985.

Cryogenic system and main parameters of the superconductor magnet-calibration stand are examined. The stand provides calibration of magnetometric equipment in magnetic fields up to 5 T with a field homogeneity up to 0.001%/cm in a warm work volume of about 60 cm. The superconductor solenoid is made as a cylindric bobbine with adjusting bobbines at the ends. The interior warm aperture is 90 mm. The regime of the "cold" magnetic field with the field stability in time of 0.001%/hour is provided. The data on the magnetising of different structural materials in the fields up to 5 T and 4.2 K are presented. 6 refs.; 4 figs.; 1 tab.

12048 **(JINR—R-9-85-593) Cryogenic system for the superconducting synchrotron SPIN.** Shelaev, I.A.; Alfeev, V.S.; Agapov, N.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700454.

The 1.5 GeV SPIN accelerator being constructed at JINR is a strong focusing synchrotron with an superconducting separated function magnet system. The magnet system comprises two supercells. Each of them has 12 regular FODO cells and a matched straight section. A cold part of the beam injection channel is also equipped with SC magnets, so the magnet system of the accelerator contains 52 SC dipoles and 64 quadrupoles with a 3t total weight. All the SC magnet are placed in a common helium cryostat of the boiling bath type. The external wall of the 4 m^3 bath is made of the 2.0 mm stainless steel sheet and the internal one is formed by the 0.5 mm vacuum chamber walls. The cryostat repearting the magnet system periodicity is holded by 42 supports made in the form of a cylindrical labyrinth. For thermal insulation of the 65 m total length cryostat only the 50-layer superinsulation and a vacuum case are used, so the expected cryostat heat load is approximately 400 W. The cryostat is connected with the 1600 W refrigerator by means of a 70 m helium pipe. 5 refs.: 1 fig.

12049 **(TRI-PP—86-98) Cyclotrons in 1986.** Craddock, M.K. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 5p. (CONF-8610173—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900307.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

Fifty-six years after their invention, the design, construction and improvement of cyclotrons continues at a healthy rate, while their capabilities continue to be extended. Six projects have been completed within the last two years, 13 are under way and 4 more have been approved. The trend is more and more to use superconducting magnets, and in one case a superconducting rf cavity also. The advent of efficient, though expensive, ECR ion sources capable of producing highly stripped heavy ions has killed many PIG sources and is likely to do the same to a number of injector accelerators. Cooling rings, which can store, cool and accelerate beam from a cyclotron, promise powerful improvements in performance and are becoming increasingly popular; five are under construction and more are being proposed. The challenge of high intensity has revealed new problems and provoked new solutions in both beam dynamics and rf control.

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REFER ALSO TO CITATION(S) 11951, 12007, 12151

12050 **(DOE/ER/05940—T3) Accelerator research studies: Progress report, Task B.** (Maryland Univ., College Park (USA)). Jun 1985. Contract AS05-78ER05940. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003709.

The main objectives in Task B of the research program are summarized as follows: (1) studies of the collective acceleration of positive ions from a localized plasma source by an intense relativistic electron beam (IREB), (2) studies of ways in which external control may be achieved over the electron beam front in order to achieve higher ion energies - the Beam Front Accelerator (BFA) concept, and (3) study of electron and ion beam generation in a new kind of compact pulsed accelerator in which energy is stored inductively and switched using a plasma focus opening switch. During the past year, substantial progress was made in each of these areas. Our exploratory research on the collective acceleration of laser-produced ions has confirmed the acceleration of C, Al, and Fe ions to peak energies in excess of 10 MeV/amu. In addition, studies of the relation between collective ion acceleration and electron beam propagation in vacuum have shed new light on the experimental processes that lead to energy transfer from electrons to ions. Meanwhile, extensive progress has been made in our attempts to use analytical theory and numerical simulation to model ion acceleration in these systems. Our resultant improved understanding of the processes that limit the peak ion energy has had a profound impact on our plans for further research in this area. Studies of the Compact Pulsed Accelerator have included both ion and electron beam extraction from the device. Its potential to reduce the volume of pulse power sources by an order of magnitude has already been demonstrated, and plans are currently underway to scale the experiment up to voltages in the 1 MV range.

12051 **(DOE/ER/05940—T4) Accelerator research studies: Progress report.** (Maryland Univ., College Park (USA)). Jun 1985. Contract AS05-78ER05940. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003347.

Our major goals for the present contract year have been (1) to complete both the beam physics studies with the 12-lens channel section and the single-lens Ph.D. project of P. Loschialpo; (2) to add 24 lenses and thereby complete the construction of the 36-lens transport channel; and (3) to initiate computer stimulation studies of our experiment. All of these goals are being met; in addition, conceptual studies were initiated for a longitudinal beam compression program proposed to follow the ongoing beam transport project. Two major highlights of our research are worthy to be singled out. One is the experimental finding that our beam emittance at the end of the 12-lens transport section is only about 40% higher than the intrinsic theoretical emittance due to the cathode temperature. The other is the investigation of the effects of nonlinear focusing and space-charge forces which closes a gap in our understanding of the behavior of intense beams compared to beams with negligible space charge.

12052 **(DOE/ER/40120—1) Experimental, theoretical and computational studies of the Plasma Beat Wave Accelerator: Progress report for the period 1 May 1983-30 April 1984.** Joshi, C.; Chen, F.F. (California Univ., Los Angeles (USA). Dept. of Electrical Engineering). Oct 1984. Contract AS03-83ER40120. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003458.

The theoretical work on beat wave laser-plasma acceleration has progressed on two fronts. The first is concerned with direct support of the present experiment, and includes calculations of trapping thresholds, expected wave amplitudes, and tolerance to inhomogeneities. The second front attempts to identify some of the limitations of present laser acceleration schemes and to resolve them by the development of new ideas for advanced acceleration concepts. Progress made in the area of computer simulations is reported, including two dimensional simulations to see whether a parameter regime can be identified which reproduces the results given by the one dimensional simulations. Also, a concept referred to as the "Surfatron," in which a dc magnetic field deflects particles perpendicular to beat waves in order to keep the particles phase locked to the waves, has been simulated, and the scaling law for energy gain was confirmed. Experimental efforts are also discussed in which plasma waves are driven by laser beams to accelerate particles. Experiments are continuing with the laser pulse of 1 ns. A theta pinch plasma source is under development. Experiments are planned for optical mixing with parallel and anti-parallel beams. (LEW)

12053 (INIS-SU—369, pp 15-19) **Suppression of longitudinal instability during beam passage through the critical energy in the IHEP accelerator.** Ado, Yu.M.; Kardash, A.A.; Myaeh, Eh.A.; Ptashkov, P.T.; Smirnov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Longitudinal beam instability is observed in the critical energy region at the IHEP accelerator. The purpose of this work was criterium determination, during which satisfaction instability behind critical region doesn't constitute a seriousdanger. Efficiency of this instability suppression by means of a specially developed system for beam transport through the critical energy was investigated experimentally. Experimental data agree well with calculational results. At 4 x 10^{12}proton/pulse intensity bunches were shortened more than two times during the operation of the system for beam transport through the critical energy.

12054 (INIS-SU—369, pp 30-33) **Experimental study on the beam coherent transverse instability in the IHEP accelerator.** Ado, Yu.M.; Lebedev, O.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of experimental investigation into coherent transverse beam instability in the IHEP accelerator to check the suggestion, that a reflected magnetic field in vacuum chamber walls cannot link bunches between themselves during spread of bunch intensities causing spread of coherent frequences of bunches, are given. Increment dependences on the number of accelerated bunches and on the ratio of intensities in bunches for different acceleration regimes are presented. Estimated increment value constituted approximately 140 ssup(-1).

12055 (INIS-SU—369, pp 43-48) **System for orbit vertical correction in the ITEP proton synchrotron.** Alekseev, N.N.; Bol'shakov, A.E.; Zavodov, V.P.; Ryabtsev, A.S.; Skachkov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

To improve correction quality of orbit vertical stability in the ITEP synchrotron, a new correction system oriented on automated control has been developed. Coils generating flat correction field in gaps of main magnetic units were applied instead of ironless correctors. Technique for choosing an optimal correction mode is presented. Commissioning of the new system for correction of orbit vertical displacements permitted to improve accelerated beam intensity by approximately 10%.

12056 (INIS-SU—369, pp 57-60) **Experience of using tipless permanent magnet quadrupole lenses on the I-2 linear accelerator.** Kapchinskij, I.M.; Skachkov, V.S.; Artemov, V.S.; Kujbida, R.P.; Lazarev, N.V.; Stolbunov, V.S.; Ehdemskij, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Experience of using two solid magnetic quadrupole lenses (SMGL) in a matching channel of the ITEP I-2 linear accelerator, where destruction of high-current electromagnetic lens winding took place after 17 year operation, is described. The two SMQL had a rod structure. They were made of samarium-cobalt rods contained in 7.4 mm diameter brass shells. SMQL mounting was performed without accelerator disassembly and its shut-down for a long time. SMQL operational experience in the I-2 accelerator confirms conclusions of their application expedience in drift tubes and accelerated particle transport channels.

12057 (INIS-SU—369, pp 172-174) **On a possibility of multicharged ion acceleration by a slow Langmuir wave in a relativistic electron beam.** Bonch-Osmolovskij, A.G.; Reshetnikova, K.A. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Under certain conditions relativistic electron beam is known resonance interacting with slow electromagnetic wave, excited in the structure with external HF generator. At that, a strong density modulation propogating along the beam axis with a velocity close to the wave phase velocity occurs and Langmuir wave is generated, the amplitude of which at ordinary parameters of the beam reaches (20-30) MV/m. The possibility to use the mechanism for the capture of multicharge ions by the wave and their acceleration to the energy, sufficient for the injection into a heavy-ion synchrotron (injection energy >=10 MeV/nucleon) was studied numerically. The possibility of 20 MV/m field production for the distance of 1 m is shown. Total length of the accelerator for the energy 20 MeV/nucleon constitutes 5 m. Travelling wave of low phase velocity and a large amplitude can be generated, when relativistic electron beam interacts with slowing-down structure of spiral waveguide type, which is enclosed in a metal casing.

12058 (INIS-SU—369, pp 175-177) **Study on the H^- beam generation in reflectional systems.** Bystritskij, V.M.; Krasik, Ya.E. (Tomskij Politekhnicheskij Inst., USSR. Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of first experiments on H^- beam generation in a reflectional tetrode are presented. The mode of charge-exchange tandem-accelerator was used. Ion diode is a tetrode with film-grid hollow anode 100 mm in diameter. At the first stage of experiments control measurements of background radiation yield of ^{13}N in the tetrode without polyethylene coating of the cathode (aluminium, stainless steel), with different number of grids on the anode, as well as without them, are made. At the second stage of experiments the measurements are conducted with anode, made of a film 0.33 mg/cm^2 thick, 3 grids and a cathode, covered by polyethylene layer. The third stage of experiments is conducted with an anode and a short-circuited spark gap. No evident dependence of H^- relative yield on the amplitude of the accelerator current in the range (10-20 kA) was detected. Conclusions are made on different mechanisms of H^- generation in reflectional and magnetically-insulated high-current diodes.

12059 (INIS-SU—369, pp 178-182) **On a possibility of using electron rings for heavy ion acceleration.** Aleksakhin, Yu.I.; Sarantsev, V.P. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A variant of heavy ion collective accelerator, where every electron ring is used multiple times, is described. The possibility to produce uranium ion beam with an intensity of 3 x 10^{13} ions per second is shown. Electron ring, formed in the adhezator, is loaded with ions and kept in the "waiting room" for some time, necessary to attain the required charge degree. Later, the ring is transported to the region of dropping magnetic field and is accelerated. Then, the ring is transported to the region of rapidly rising magnetic field, where the condition of ion confinement is violated. The ions are "shaken out" of the ring. Slowing-down line serves for the ring return to the "waiting room". The time for attaining uranium ion charge degree Z=19 does not exceed 1 ms, so that at the operating frequency of electron ring generator 50 Hz each ring can be reused 20 times.

12060 (INIS-SU—369, pp 183-185) **Method for calculation of relativistic electron high-current Brillouin beam sources.** Aleksakhin, Yu.I.; Nefed'ev, V.O.; Shchinov, B.G. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Electron Brillouin beams, characterized by a zero phase volume and the minimum radius in a magnetic field of given intensity, are widely used in SHF devices and accelerating facilities. A synthesis method applicable with quite insignificant restrictions to magnetic field geometry in the simplest case of a continuous axial symmetric beam, emitted by a plane cathode, has been suggested.

12061 (INIS-SU—369, pp 186-189) **Metal ion collective acceleration in direct partially neutralized high-current electron beams.** Ajrapetov, A.Sh.; Kolomenskij, A.A.; Kostrikina, E.A.; Orlov, D.B.; Yablokov, B.N. (AN SSSR, Moscow. Fizicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of experimental investigation of ion collective acceleration in direct high-current electron beams (HEB) are presented. Electron beam transport in a metal tube with HEB energy range 400-500 keV, current range 50-100 kA, 40 ns pulse duration is studied to determine the effect of HEB current density on ion acceleration. From the Lewis diode a beam was injected to channels of various diameters from 16 to 120 mm, 100 mm long, and to a conical channel 100 mm long. In the conical channel the beam transport without losses is performed. Beam density equalled 300 kA/cm^2. In the experiments on production and acceleration of metal multicharge ions a diode with conical metal electrodes served as HEB and accelerated ion source.Energy dependence of ionization degree of accelerated ions of iron, copper and carbon for a drift tube 16 mm in diameter, is shown. A compared with the case of a tube 60 mm in diameter, the maximum energy of iron ions hasincreased approximately two fold. Ionization degree of low-energy ions lies in a wide range. Maximum energy ions have average value of ionization degree.

12062 (INIS-SU—369, pp 190-193) **On the formation of an instantaneous orbit in a synchrotron.** Bashmakov, Yu.A.; Karpov, V.A. (AN SSSR, Moscow. Fizicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

In the process of injection into a synchrotron amplitudes of particle betatron oscillations can be comparable with the dimensions of the synchrotron working region, which means that special attention should be paid to the formation of the optimum instantaneous orbit. Basides, a necessity to calculate the orbit frequently arises at the end of the acceleration cycle, when particle dump onto internal targets or their extraction from the synchrotron take place. In the paper the method for calculation of particle trajectories in the synchrotron is described. According to the method the program of numerical calculation of both separate particle trajectories and closed instantaneous orbit was developed. The method suggested is based on the presentation of the accelerator magnetic structure as a sequential set of discrete elements. All the elements can be divided into the following main groups: free rectilinear gaps, rectilinear gaps with stray magnetic field, magnetic sectors, rectilinear gaps with accelerating electric field. The calculations made according to the method described have shown its high efficiency. The program developed is used for the simulation of the injection into the "Pakhra" synchrotron.

12063 (INIS-SU—369, pp 194-196) **To the theory of ion acceleration by electron beam Cherenkov wave in a slowing-down system.** Grishin, V.K.; Reshetnikova, K.A. (Moskovskij Gosudarstvennyj Univ., USSR; Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

For collective methods of ion acceleration, using as an example a waveguide system with an alternating pitch spiral the Cherenkov mechanism of electromagnetic wave generation by relativistic electron beam in a slowing-dow structure is considered. It is assumed, that electron beam is injected into the spiral waveguide, parameters of which at the inlet ensure the Cherenkov resonance. Then the spiral parameters vary in sch a way that the electrons remain in the resonance with the wave. It can be attained at the expense of the spiral winding slope. Thus, the field generation is "delayed", and the value of energy,delivered by the beam to the system, increases. On the basis of kinetic equation and laws of energy and pulse conservation, estimate of beam and system parameters, required for ion capture, are given.

12064 (INIS-SU—369, pp 197-202) **Investigation of electron selfcapture into a ring bunch in a collective accelerator adhezator.** Zhabitskij, V.M. 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The method for captured current value calculation in the case of a relativistic electron beam injection into weak-focusing permanent magnetic field of a collective accelerator adhezator is described. The process of variation of the number of particles in a ring bunch is described. During the beam injection the number of particles increases and reaches a certain maximum value, after that the limitation of circulating current, conditioned by the balance between newly injected and particles lost on the nozzle, takes place. On completing the injection, a decrease in the circulating current takes place, as a result of which the radii of electron orbits decrease. It results in the capture of some electrons into the ring bunch. Numerical evaluations of the value of captured particles are presented.

12065 (INIS-SU—369, pp 203-205) **To the calculation of an accelerating structure of an ion collective accelerator.** Aseev, G.G.; Korostelev, A.N.; Kuznetsova, G.G.; Lymar', A.G.; Martynenko, P.A.; Khizhnyak, N.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The calculation of an accelerating structure of a linear collective ion accelerator is presented. In the given accelerator the accelerating field is formed by longitudinal gradient of electron flux space charge potential. Electron flux propagates in a corrugated screen and is modulated in time. The field value is determined by the flux perveance and screen geometry. The focusing is provided by external magnetic field. Dependences of the average energy, the number of ions and energy spread on the number of accelerating cells are presented. The results of numerical analysis testify to a high stability of the acceleration process in the given accelerating system.

12066 (INIS-SU—369, pp 209-211) **Charged particle impact acceleration.** Bessonov, E.G.; Serov, A.G. (AN SSSR, Moscow. Fizicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

In the impact acceleration mode beam particles are injected to non-excited accelerating structure of a linear accelerator. On the injection completion, a wave of accelerating magnetic field moving without dispersion is excited, which reaches the beam particles and accelerates them. A new regime of impact acceleration with particle acceleration in the potential barrier, flat-top permitting to realize the compression of not only relativistic but also of non-relativistic beams, is suggested. Dynamics of particle acceleration is considered. The degree of a beam compression is determined. Realization of particle impact acceleration in high-current linear accelerators will permit to produce high-energy beams with the current $> 10^4$ A.

12067 (INIS-SU—369, pp 215-217) **Longitudinal Coulomb limitation of current on synchronous phase variation.** Budenov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

As applied to accelerators with synchronous phase variation the dependence of beam critical current along the accelerator on the beam longitudinal emittance is investigated.

12068 (INIS-SU—369, pp 222-225) **Beam quality during integer resonance passage in a kaon factory.** Sarkisyan, L.A.; Chernyshenko, T.A. (Moskovskij Gosudarstvennyj Univ., USSR. Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Proton beam quality during integer resonance passage in an circular isochronous cyclotron is studied in detail. The investigations carried out have shown, that in the cyclotron the reguirements for the energy gain per cycle and for the tolerance on the field resonance harmonics are determined by phase motion and admissible distortion of closed orbit in resonance zones. It permits to use approximately 5 MeV energy gain per cycle at the tolerance for the field resonance harmonics approximately 0.25-0.5 Oe in circular cyclotrons with proton acceleration up to the energy 4 GeV. It is shown, that both in the cyclotron and in the linear system post resonance increase in the amplitude of proton free radial oscillations is absent.

12069 (INIS-SU—369, pp 226-229) **Effect of proper eddy fields on the beam characteristics in an accelerator with spatial-uniform focusing.** Bragin, S.E.; Senichev, Yu.V. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The effect of proper curl fields on proton beam characteristics in a linear accelerator with spatial-uniform focusing in one-mode approximation without automatic control system is studied. The beam interacts with the field in the near axis region between electrodes. Field distortion in the resonator at the expense of operating oscillation excitation by the beam was considered. It is shown, that when 50 mA beam was accelerated, potential on the electrodes decreased from 122 kV to 95 kV. At that, capture coefficient for HF buncher decreased from 98% to 30%. The proper curl component of the beam field affects considerably the radial motion. With the current change from 5 mA to 50 mA the emittance increased in both planes by approximately 30%. Conclusions are made, that either conventional method - input of extra power at the moment of the beam acceleration, or a decrease in the rate of the accelerator synchronous phase change can be used to maintain a high capture coefficient.

12070 (INIS-SU—369, pp 325-327) **Calculation of radiation field topography in ion linacs.** Khizhnyak, N.A.; Sidorenko, I.S.; Shilyaev, B.A.; Shulika, N.G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Conditions for material operation in proton accelerators are complicated and their choice represents a complex problem. Results of calculation of topography of neutron flux spatial density around the resonator of the proton accelerator are presented. Distribution of destructive dose over the accelerator axis is displayed.

12071 **(SLAC/AP—54) A note on the relationship between the emittance, the beta function and the energy in a linear collider.** Rees, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1986. Contract AC03-76SF00515. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003667.

Scaling laws for linear colliders are considered for the case of laterally round Gaussian beams and for the case that mutual pinching of the beams can be ignored. Based on these assumptions, the relationship is found between the interaction area, beta function, beam emittance, and energy for a linear collider in order to show the need for substantial improvements in the feasible values of accelerator parameters to reach a center of mass energy of 0.7 TeV. Pinch is then taken into account. (LEW)

12072 **(TRI-PP—86-92) Control of rf leakage in the TRIUMF cyclotron.** Dohan, D.; Fong, K.; Pacak, V. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 4p. (CONF-8610173—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900313.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

The TRIUMF vacuum chamber and beam gap form a cavity with resonant rf modes close to the operating frequency. The resultant leakage into this beam cavity poses significant problems to beam diagnostic equipment and can damage non-cooled components in this volume. Model studies, machine measurements and theoretical calculations have been carried out in order to understand and control the leakage. The amount of this rf leakage is shown to depend critically on the alignment at the dee gap. Two dominant leakage modes have been identified and their excitation mechanisms have been studied. The total leakage field depends critically on the amplitudes and phases of these parasitic modes. Through suitable superposition of these modes, the leakage can be reduced and its pattern modified by the realignment of the top and bottom ground arm tips. Reductions in the leakage by 10 to 15 dB have been achieved on the model and on the machine. The major cause of heating of the resonator strongbacks has been found to be due not to the leakage currents themselves, but to multipactoring effects in the beam cavity driven by leakage electric fields.

12073 **(TRI-PP—86-94) SPUNCH: A space charge bunching computer code.** Baartman, R. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 2p. (CONF-8610173—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900309.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

Even at relatively low currents, space charge forces can significantly influence the effectiveness of a bean buncher. A computer code has been written to simulate longitudinal beam motion in the presence of space charge. This program is relatively fast because it is one-dimensional and because particle-particle forces are calculated beforehand and stored in a table.

12074 **(TRI-PP—86-96) Third harmonic flattopping in the TRIUMF rf cavity.** Enegren, T.; Dohan, D.; Fong, K.; Pacak, V.; Worsham, R. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 4p. (CONF-8610173—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900310.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

The TRIUMF resonant cavity is being modified to allow the simultaneous excitation of both the first and third harmonic resonances for rf waveform flattopping. For beam operation, the value of the fundamental frequency must be adjustable while maintaining a precise 1 to 3 ratio of the fundamental to the third TEM mode frequencies. Three tuning methods have been considered and will be described. The preferred method incorporates specially designed ground panels with a 10 cm dee-to-ground spacing at the root and a hinged section providing an adjustable spacing at the high voltage end. Movement of the hinged section perturbs the cavity and hence the frequency of the first and third TEM modes. The amount of the frequency perturbation is different for each mode depending on the location of the hinge point. Two sets of ground arms with different hinge locations are required to provide the necessary two degrees of freedom. The advantages of this method over previous methods will be discussed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 11324, 11608, 11923, 11956, 12176

12075 **(BNL—38853) Quench propagation across the copper wedges in SSC dipoles.** Ghosh, A.K.; Robins, K.E.; Sampson, W.B. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 4p. (CONF-860914—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003472.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

The effect of copper wedges on quench propagation in SSC windings has been studied. The results indicate that the turn-to-turn quench transit time for conductors separated by an insulated copper wedge can be predicted with reasonable accuracy from the bulk quench properties and the mean wedge thickness.

12076 **(BNL—39091) Analysis of surface contaminants on beryllium windows.** Gmur, N.F. (Brookhaven National Lab., Upton, NY (USA)). Dec 1986. Contract AC02-76CH00016. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004176.

It is known that various crystalline and liquid compounds form on the downstream surfaces of beryllium windows exposed to air. It is also known that the integrity of such windows may be compromised resulting in leaks through the window. The purpose of this report is to document the occurrences described as they pertain to the NSLS and to analyze, where possible, the various substances formed.

12077 (BNL—52006, pp 3-6) **General features of accelerator magnets.** Brianti, G. (European Organization for Nuclear Research, Geneva, Switzerland). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The magnet system is the heart of a proton synchrotron and normally its most expensive component. Its quality, namely the accuracy of the magnetic field distribution inside the aperture and around the ring, has a strong influence on the performance of the accelerator. An important additional requirement is that this accuracy must be insured at all field levels experienced by the beam during the cycle. In machines with classical magnets the ratio Bmax/Bmin may be more than 50, while in s.c. it may exceed 20. In most cases, the beam measures the magnet considerably better than the most sophisticated system of magnetic measurements, especially in the case of high order multipolar errors (resonances up to 15th order, corresponding to 30 poles can be seen by the beam). The state of the technology for superconducting accelerator magnets and related cryogenics is reviewed.

12078 (BNL—52006, pp 7-12) **Magnet R & D for the SSC.** Tigner, M. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The recently compiled Conceptual Design Report of the SSC calls for two proton beams circulating on separate racetrack paths, and colliding repetitively at interaction regions on the straightaways. The design energy of 20 TeV per proton will allow the subquark scale to be reached with adequate resolution, and the proposed luminosity of 10^{33} cm^{-2} s^{-1} will give a useful event rate. The grouping together of the interaction regions (IRs) in clusters on the diametrically opposed straight sections allows easier and cheaper access to experimental and support areas, without inducing beam control problems. In the Conceptual Design, the main west cluster comprises the injector complex, main laboratory and offices, plus two IRs and two utility areas for beam injection and abort; the east cluster has four IRs, with two to the be built immediately, and two reserved for later construction. The two long arc sections of the SSC each contain 166 cells: each of these arc cells is 192 m long, and consists of two half-cells of five bending magnets between two quadrupoles of opposite polarity. The magnet arrangement and lattice functions within a cell are shown.

12079 (BNL—52006, pp 13-18) **Development of superconducting dipoles for UNK.** Ageev, A.I.; Andreev, N.I.; Balbekov, V.I.; Bulatov, E.A.; Dmitrevskiy, Yu.P.; Dolzhenkov, V.I.; Gertsev, K.F.; Gridasov, V.I.; Kozub, S.S.; Myznikov, K.P.; Sytnik, V.V. (Institute for High Energy Physics, Serpukhov, USSR). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

IHEP carries on work on simulation of full-scale dipoles for UNK. A few full-scale warm iron magnets made of a superconducting material having a higher current density jc have been manufactured. In 1985 they were tested at a force-circulating test facility. Their design and test results will be presented in what follows. During the recent years the quality of commercially available superconducting material has been improved considerably and its current density jc increased. This allowed to simplify the dipole design, to improve its characteristics and save the amount of the superconducting wire. A cold iron dipole has been designed at IHEP with these factors taken into account. The comparison of its characteristics with those obtained for a warm iron dipole is presented.

12080 (BNL—52006, pp 19-24) **Superconducting dipole and quadrupole magnets in KEK.** Hirabayashi, H.; Tsuchiya, K. (KEK National Lab. of High Energy Physics, Ibaraki-ken, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The superconducting magnets, both dipoles and quadrupoles, that were designed and tested for the beam lines and accelerators at KEK are described. In these magnets, various conductors, winding schemes and cooling modes were used.

12081 (BNL—52006, pp 25-34) **Magnet research and development for the CERN large hadron collider.** Perin, R. (CERN, Geneva, Switzerland). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

After a short introduction on the proposed CERN Large Hadron Collider (LHC) and its size in terms of magnets and cryogenics, the main features of the preliminary design of the required 8 to 10 Tesla superconducting magnets are described in some detail. Some general aspects of the R & D program for the magnets, which has been recently started in close collaboration with European Laboratories and Industries are presented. A brief account of the initial steps in the program and of the present state is also given.

12082 (BNL—52006, pp 35-39) **Magnets for RHIC.** Willen, E.H. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The Relativistic Heavy Ion Collider (RHIC) is a proposed research facility at Brookhaven National Laboratory for the study of extreme states of matter. By colliding two beams of ions, up to gold in mass and at energies up to 100 GeV/amu, high energy density will be achieved within the nuclei of the colliding ions, leading to a variety of fundamental effects not heretofore observed. The physics to be explored by this Collider is an overlap between the traditional disciplines of nuclear physics and high energy physics. The machine is proposed for construction in the now-empty tunnel built for the former CBA project. In addition to the tunnel, various other facilities needed for the machine are in place, including experimental halls, a beam transfer tunnel from the AGS, and a refrigerator for providing cryogenic helium. The Collider, including the magnets, is in an advanced state of design. The layout of the basic RHIC regular arc cell is shown. Seventy-two such cells are required to complete one ring. The lattice of magnets chosen in the design reflects the need for strong focussing to maintain a small beam size while coping with the severe intrabeam scattering of heavy ion beams. Each cell is 29.622 m long; it deflects the beam by 77.7 mrad and has a betatron phase advance of 90°. The layout of the magnets to bring the beams into collision is shown. The characteristics of the dipole and quadrupole magnets required for the arcs and for the intersection regions are given.

12083 (BNL—52006, pp 40-41) **Status of magnet technology and future trends.** Tollestrup, A.V. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Reasons why the development of magnet technology should be supported are discussed. The requirements of quality control and failure-free operation has added a new dimension to accelerator magnet design and production. The cost of developing a successful accelerator magnet is discussed.

12084 (BNL—52006, pp 45-50) **New developments in niobium-titanium superconductors.** Larbalestier, D.C.; Lee, P.J.; Chengren, L.; Warnes, W.H. (Univ. of Wisconsin, Madison). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Niobium-titanium composites have been fabricated on an industrial scale since about 1966. After early optimization efforts, their properties reached a plateau from about the mid 1970's and the principal development efforts then went into manufacturing scale up and cost optimizations. The present paper was prepared for the May 1986 workshop on Superconducting Magnets and Cryogenics, organized by ICFA. It briefly reviews recent work relevant to the applications of Nb-Ti for accelerators. An overview of the magnet design aspects of superconductors was recently made, as well as the microstructural and flux pinning properties. Both Nb-Ti and Nb_3Sn conductors were considered in these reviews.

12085 (BNL—52006, pp 51-55) **Survey of high field superconducting materials for accelerator magnets.** Scanlan, R.; Greene, A.F.; Suenaga, M. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The high field superconductors which could possibly be used in accelerator dipole magnets are surveyed, and then these candidates are ranked with respect to ease of fabrication and cost as well as superconducting properties. The superconducting properties which are important for applications involving electromagnets are discussed. A major difference between NbTi and the other potentially useful superconductors is its ease of fabrication. NbTi is a ductile alloy which can be processed from cm-size rods to micron-size filaments by standard extrusion and cold drawing techniques. On the other hand, the other high-field superconductors are intermetallic compounds which can be deformed only about 0.2% in tension before they fracture and become useless in superconducting wires. In order to utilize these materials in the form of continuous multifilamentary superconductors, a number of special fabrication techniques have been developed. Within the group of intermetallic compound superconductors, fabrication technology is most advanced for Nb_3Sn. Nb_3Sn and NbTi are evaluated with respect to their near-term use in dipole magnets.

12086 (BNL—52006, pp 56-59) **Composite superconductors for UNK magnets.** Fil'kin, V.Y.; Gogulya, V.F.; Kosenko, V.P.; Kutniy, V.E.; Nikulenkov, E.V.; Nikulin, A.D.; Plashkin, E.I.; Slabodchikov, P.I.; Zelenskiy, G.K.; Dmitrevskiy, Yu.P.; Myznikov, K.P. (All-Union Research Institute for Nonorganic Materials named after Bochvar, Moscow, USSR). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The batches of 0 0.85 mm wires having 10 μm and 6.5 μm in diameter filaments embedded into a copper matrix have been manufactured for UNK superconducting dipoles. The optimal modes of thermal and mechanical treatment as well as measures designed to raise the homogeneity of superconducting filaments allowed to obtain the value of the critical current density in wires of up to 2.7 x 10^5 A/cm^2 for the 5 T field and 4.25 K temperature. The models of superconducting dipoles manufactured from such wires had the bore field induction of at least 5 T without degradation, the tolerable levels of residual fields and ac losses.

12087 (BNL—52006, pp 60-62) **Electrophysical and structural properties of multifilamentary superconducting niobium-titanium wire.** Aksenova, E.N.; Dorofejev, G.L.; Klinenko, E.Yu.; Kurchatov, I.V.; Gogulya, V.F.; Nikulenkov, E.V.; Nikulin, A.D.; Potanina, L.V.; Zelensky, G.K. (Institute of Atomic Energy, Moscow, USSR). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The connection of the current-carrying capacity and losses for Nb-Ti multifilamentary superconducting wires with microstructure and inhomogeneity of their filaments is formed. Superconducting wires were manufactured by a simultaneous plastic deformation and heat treatment of the Nb-50 weight %Ti alloy and a copper stabilizing matrix. Fragments of the wire cross section at one of the manufacturing stages are shown.

12088 (BNL—52006, pp 63-65) **Teledyne's historical contribution to developing superconductivity.** McDonald, W.K. (Teledyne SC, Huntsville, AL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Of the contributions made to superconductivity by Teledyne Wah Change Albany (TWCA), two have been outstanding. The first is the establishment of a stable and low cost NbTi alloy. Estimates of cost savings passed along to conductor manufacturers and, subsequently, to the applications of superconductivity range between $24,000,000 and $31,000,000 over the years from 1980 to present. Secondly, TWCA has understood the necessity of cooperating with the scientific community in order to understand critical relationships of metallurgy to superconductivity characteristics. The knowledge gained is integrated into alloy production on a commercial basis. The most notable example is the recent increase in current density prospects for the proposed Superconducting Super Collider.

12089 (BNL—52006, pp 66-70) **Mass production of superconducting materials Nb and NbTi.** Drost, E.; Hoermann, M. (W.C. Heraeus, Hanau, West Germany). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The manufacturing processes for Nb and NbTi semifinished products (rods, tubes and sheets) for superconducting applications are described, involving electron beam melting of pure Nb, vacuum arc melting of the NbTi alloy, hot direct extrusion of NbTi alloy billets and additional hot and cold working techniques. The metallurgical and mechanical properties of the mill products as well as superconducting properties for NbTi wires, achieved by wire producers, are outlined.

12090 (BNL—52006, pp 71-80) **Recent advances in the commercial scale production of Nb-46.5wt%Ti alloy.** Asfahani, R.I.; Murty, Y.V.; Sentner, D.A.; Kumar, P. (Cabot Corp., Boyertown, PA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Nb-Ti alloys are used in superconducting magnets as current carrying members. In these applications, the binary alloys, containing 46-53/sup wt/%Ti, are fabricated to fine filaments (micron size) applying standard metal working techniques but using proprietary processing sequences. The alloys are arc cast using consumable VAR process. Melting point and density differences between Nb and Ti present interesting problems in producing homogeneous alloys. Macro- and microsegregation in as-cast product has been shown to affect final superconducting properties as well as fabrication characteristics. The present study was aimed at producing homogeneous cast product. The extent of solute segregation, in the as-

cast product and the importance of controlling the remelting operation and thermomechanical processing are discussed.

12091 (BNL—52006, pp 81-84) **State of the art in fine filament NbTi superconductors at IGC.** Hemachalam, K.; King, C.; Scudiere, J.; Zeitlin, B. (Intermagnetics General Corp., Guilderland, NY). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The proposed Superconducting Super Collider (SSC) in the US and plans for a Large Hadron Collider LHC at CERN are likely to require micron size filaments to reduce micron size filaments to reduce magnetization effects at the low injection fields envisioned. Superconductors of NbTi, designed to meet these requirements, are described. These conductors contain from 6000 to 36,613 filaments. Results are presented on NbTi conductors made by multiple extrusion techniques. Filament sizes of between 2.2 and 17 micron have been obtained. Current densities of between 2400 A/mm^2 and nearly 3400 A/mm^2 at 5 Tesla have been achieved. Metallurgical aspects of these conductors are presented using both optical and SEM views of conductor cross section and filament surface.

12092 (BNL—52006, pp 85-88) **Fine filament materials for accelerator dipoles and quadrupoles.** Gregory, E.; Kreilick, T.S.; Wong, J. (Supercon Inc., Shrewsbury, MA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

A review is given of the state of the art of singly stacked materials which are available in production quantities and which have been supplied for prototype RHIC and SSC magnets. Also described are some development programs that are presently underway in an effort to improve upon the already outstanding properties of materials for these applications.

12093 (BNL—52006, pp 93-94) **Fine filament NbTi superconductive composite.** Hong, S.; Grabinsky, G.; Marancik, W.; Pattanayak, D. (Oxford Superconducting Technology, Carteret, NJ). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The large superconducting magnet for the high energy physics accelerator requires fine filament composite to minimize the field error due to the persistent current in the filaments. New concepts toward the fine filament composite and its cable fabrication are discussed. Two-stage cables of fine wire with intermediate number of filaments were introduced. The first stage was six wires cables around one and in the second stage this was used to produce a Rutherford cable. The advantage of this process is in the ease of billet fabrication since the number of filaments in a single wire is within the range of easy billet fabrication. The disadvantage is in the cable fabrication. One of the major concerns in the fabrication of fine NbTi filaments composite in a copper matrix is the intermetallic compound formation during the extrusion and heat treatment steps. The hard intermetallic particles degrade the uniformity of the filaments and reduce the critical current density. The process of using Nb barrier between the filaments and copper matrix in order to prevent this CuTi intermetallic particle formation is described.

12094 (BNL—52006, pp 95-98) **Recent developments of various superconducting cables for accelerators.** Sakai, S.; Moriai, H.; Ishigami, Y.; Aihara, K.; Saito, R. (Hitachi Cable, Ltd., Ibaraki-ken, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Hitachi Cable, Ltd. has produced many types of superconducting cables for detector magnets, dipole and quadrupole magnets, and others. For example, they are Al stabilized Nb-Ti composite cables for the colliding beam detector magnets and Rutherford type cables for dipole and quadrupole magnets. Through these developments, Hitachi has contributed to the completion of many projects in high energy physics. In a few years, Hitachi Cable has developed high J/sub c/ and very fine filament Nb-Ti superconducting wires. Features of the developed superconducting composites are as follows: (1) high critical current density of 2610 A/mm^2 at 5T was attained by the moderate heat-treated and high homogenized 3-4μmphi filaments Nb-46.5%Ti composites; and (2) the most typical feature in wire production is the application of hydrostatic extrusion; this decreases the formation of compounds between Cu and Nb-Ti and no multiple necking in filaments because of the extrusion at relatively low temperature.

12095 (BNL—52006, pp 99-102) **Superconducting wire and cable for big accelerators.** Tanaka, H. (Furukawa Electric Co., Ltd., Tokyo, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Although large superconducting dipole magnets and other superconducting magnets for the beam line and the beam detector have been manufactured and successfully tested and operated, the development trend of the superconductors for the future application should be decided on a cost efficient point of view. For such an important issue and individual technological difficulties, it is significant to organize the close cooperation with physicists, laboratories and industries over the international level.

12096 (BNL—52006, pp 103) **Large-scale production of HERA-superconductor.** Maix, R.K.; Marti, H.P.; Salathe, D.G. (BBC Brown Boveri & Cie, Ltd., Zuerich, Switzerland). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

A contract for the fabrication of 465 km HERA cable which corresponds to 52 tons is discussed. For that production, all of the Nb-47.5 wt%Ti rods have already been delivered by TWCA (Teledyne Wah Chang). Superconductor billets corresponding to 28 tons of wire have been extruded. About 3 tons of that material is at .45 final diameter. The rest is on its way through the various wire drawing and annealing steps. The fabrication process is described.

12097 (BNL—52006, pp 104-105) **Development of cable for HERA dipoles at L.M.I.** Ceresara, S. (La Metallic Industriale Research Center, Fornaci di Barga, Italy). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Results so far obtained at LMI in the development of cable prototypes for HERA dipoles are reported. The target critical current value, 8000 A at 5.5 T, 4.6 K, has been met in the latest cable produced.

12098 (BNL—52006, pp 106-107) **Niobium-titanium wire for the HERA correction coils.** Elen, J.D.; Franken, W.M.P. (Superconductors Lips ECN, Petten, Netherlands). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Multifilament wire of 2800 Amps/mm^2 current density at 5 Tesla has been developed for the HERA correction coils and is presently in production.

12099 (BNL—52006, pp 108-110) **NbTi superconductors for accelerator magnets: large-scale production for HERA and development of fine filament conductors.** Krauth, H. (Vacuumschmelze GmbH, Hanau, West Germany). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The results of the production of 2650 km of strand material and of the keystoned cable with 23 strands for the HERA quadrupoles are presented. An average value of 2500 A/mm^{2}at 5 T and 4.2 K was obtained for the whole quantity of conductor. The measured current in the cable is more than 15 % higher than specified. In addition, a 10500 filament conductor has been produced on a full production scale to demonstrate the feasibility of the single stacking process for this type of conductor. A current density of 2300 A/mm^2 at 5 T and 4.2 K has been achieved with 5 μm diameter filaments.

12100 (BNL—52006, pp 111-114) **Superconducting properties of fine filamentary superconducting wires.** Saito, S.; Ohmatsu, K.; Takei, H.; Nagata, M.; Tateishi, H.; Onishi, T. (Sumitomo Electric Industries, Ltd., Osaka, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The dependence of critical current density, Jc, of Nb-Ti superconducting wire on deformation-thermal history and filament size was studied systematically using two types of specimens. One type, Cu matrix superconducting wires, was heat treated 1 ~ 3 times during processing. It was found the Jc strongly depends on the number of heat treatments. The other specimens, Cu-Ni matrix superconducting wires, were only cold-worked without heat treatment. The filament sizes varied from 3 μm to 0.03 μm. Jc increased sharply in low magnetic fields for specimens whose filament sizes were below 1 μm.

12101 (BNL—52006, pp 117-122) **Present status of development of Nb_3Sn wires for high energy particle accelerators.** Suenaga, M. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Present status of development of Nb_3Sn wires which are suitable for the use in magnets for high energy particle accelerators is reviewed. Particular emphasis is placed on comparisons of critical current densities and magnetization of wires which were made on commercial scale and of wires which are in various developmental stages.

12102 (BNL—52006, pp 123-126) **Fabrication of new superconductors.** Wada, H.; Tachikawa, K. (Tsukuba Labs., Ibaraki, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

New high-field superconductors recently developed at the National Research Institute for Metals, Japan, have been reported with an emphasis upon their fabrication techniques. High-field critical current densities of bronze-processed Nb_3Sn multifilament conductors are greatly improved by titanium additions to the composite core or/and the matrix. Multifilament conductors of the C-15 V_2(Hf,Zr) Laves phase compound are fabricated on the basis of a composite-diffusion process, and found to show larger critical current densities than Nb_3Sn at fields over 12 tesla at superfluid helium temperatures. Nb_3(Al,Ge) tape conductors with a copper substrate are developed by using a novel liquid quenching apparatus, with large critical current densities for fields up to 20 tesla. Tape conductors of Nb_3Al are made by electron-beam heating travelling composite tapes of niobium and aluminum powders compacted in a niobium sheath within an electron-beam welding apparatus, showing fairly large critical current densities even above 20 tesla.

12103 (BNL—52006, pp 127-131) **Indigenous development of A-15 superconductors through in situ technique.** Sharma, R.G.; Reddy, Y.S.; Krishna, M.M. (National Physical Lab., New Delhi, India). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The preliminary results obtained on the in situ Cu-Nb_3Sn composite superconductors are reported. Two phase alloys of Cu-Nb (15 to 30 at.%) have been prepared by arc melting and rolled/drawn to fine wires and tapes without intermediate annealing. Prior to tin coating, these specimens were characterized for their T/sub c/ and J/sub c/ values. A mid point T/sub c/ of 8.8K and a self field overall J/sub c/ of 2.5 x 10^5 A.cm^{-2} (4.2K) have been obtained for specimens with 20 to 30 at.% Nb. The rolled Cu-Nb tapes with well aligned filaments show critical current anisotropy with the magnetic field direction. Cu-Nb_3Sn composite wires have been prepared by coating these wires with varying amounts of tin and heat treating them at 550°C for various periods. The best specimen has a T/sub c/ (midpoint) of 17.5K and a J/sub c/ of 3 x 10^5 A.cm^{-2} at 6T, 4.2K and 3 x 10^4 A.cm^{-2} at 12T, 4.2K. These values compare well with the published data. Studies are continuing for the optimization of various parameters. In situ Cu-V_3Ga composite wires have also been prepared and are presently begin characterized.

12104 (BNL—52006, pp 132-135) **Improved Nb_3Sn superconductor wire for high field applications.** Zeitlin, B.A.; Phillips, D.; Hemachalam, K.; Ozeryansky, G.; Scudiere, J.D.; King, C.; Hazelton, D.W.; Markiewicz, W.D. (Intermagnetics General Corp., Waterbury, CT). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The Internal Tin manufacture process has been utilized to produce Nb_3Sn wire for high energy physics and fusion applications. These conductors exhibit some of the highest critical current performance for multifilament Nb_3Sn wire achieved to date. Recently, new Internal Tin conductor geometries and titanium additions to the Nb have been combined to optimize this type of conductor for high field applications. For applications requiring low magnetization, such as in accelerator magnets, the highest current densities can not yet be utilized due to filament bridging. Critical current performance, heat treatment schedule, and wire cross section photographs are presented for these conductors.

12105 (BNL—52006, pp 136) **Development of high field superconductors at BBC.** Maix, R.K.; Salathe, D.G. (BBC Brown Boveri & Cie, Ltd., Zuerich, Switzerland). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

BBC and the Swiss Superconductor Consortium started the development of Nb_3Sn-filamentary superconductors on the basis of the external diffusion technique. This development was taken over and continued by the Swiss Institute for Nuclear Research (SIN) also in collaboration with firms of the Consortium. With this technique, 1000 m composite superconductor were manufactured by SIN. These superconductors are described.

12106 (BNL—52006, pp 141-142) **Niobium-tin wire development according to the ECN powder method.** Elen, J.D.; Hoogendam, P.; Hornsveld, E.M. (Superconductors Lips ECN, Petten, Netherlands). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

A commercial production of niobium-tin wire made according to the ECN powder method and to be used in a 12 tesla insert coil of the SULTAN test facility at Villigen (Switzerland) has been

fabricated. The development towards a decrease of the filament size in order to meet the wire specifications of the LHC system studies at CERN is outlined.

12107 (BNL—52006, pp 143-146) **Nb_3Al research and development at LMI and ENEA.** Barani, G.; Ceresara, S.; Donati, G.; Bruzzese, R.; Sacchetti, N.; Spadoni, M. (LMI Research Center, Lucca, Italy). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Problems related to the fabrication of high J/sub c/ Nb_3Al multifilamentary superconductors by Jelly roll technology are discussed. In particular, a new method called IMF (intrinsically multifilamentary), which should allow the achievement of J/sub c/ = 1500 A/mm^2 at 11.T, 4.2 K, on a multifilamentary structure, is presented.

12108 (BNL—52006, pp 147-149) **Development of bronze route Nb_3Sn superconductors for accelerator magnets.** Krauth, H. (Vacuumschmelze GmbH, Hanau, West Germany). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The present status of bronze route processed Nb_3Sn conductors is described. Tons of multifilamentary conductors have been already produced and were used in NMR, laboratory and fusion applications. Design and typical parameters of routinely produced conductors are given. The critical current requirements of accelerator magnets at the relatively low field around 10 T lead to a new parameter regime for the conductor design. By optimization it seems possible to come close to these requirements.

12109 (BNL—52006, pp 150) **Superconductor development and future trends.** Taylor, C.E. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

There is general agreement that progress in increasing J/sub c/ has been rapid and will continue. Flux pinning theory has not been a good guide because of the very complex metallurgy of NbTi as processed. Even though precipitate sizes are now much smaller than coherence lengths, improvements are still being made. The only large-scale production history for Nb_3Sn has been with bronze matrix material which has a predictable J/sub c/ of 650-850 A/mm (10 T, 4.2 K). (This is probably not high enough to be economically attractive for most accelerator applications.) Fabrication processes for NbTi and Nb_3Sn are discussed.

12110 (BNL—52006, pp 153-156) **Procedures for measuring the electrical properties of superconductors for accelerator magnets.** Sampson, W.B. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

There are three important electrical properties associated with the superconductor used to fabricate accelerator magnets. The most important is the critical current since this determines the performance potential of the magnet. The normal state resistivity and the volume magnetization are the other principal electrical parameters. Methods for measuring these parameters are presented and procedures for including self field effects and magnetoresistance are discussed.

12111 (BNL—52006, pp 157-161) **S.C.K./C.E.N. critical current set-up.** Van den Bosch, A.; Biermans, F.; Cornelis, J.; Maene, N. (S.C.K./C.E.N., Mol, Belgium). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The Materials Physics Department set-up for measuring critical currents on superconductors allows a maximum current of 1000 A to be sent through a specimen at magnetic induction fields up to 13 tesla. The upper limits are largely sufficient for measuring wires to be used in the projected large hadron collider (LHC). Up to now the maximum current intensity used in the system, at maximum field strength at 4.3 K, was 510 A. Data related to this and other experiments are given and discussed. The system is used in a program related to the optimization of the fabrication process of home made Nb_3Sn multifilament wires.

12112 (BNL—52006, pp 162-165) **Device for precision dimensional measurement of superconducting cable.** Carson, J.A.; Barczak, E.; Bossert, R.; Fisk, E.; Mantsch, P.; Riley, R.; Schmidt, E.E.; Schmidt, E.E. Jr. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

A need for continuous sampling of the dimensions of superconducting cable has lead to the development of a machine for that purpose. This device measures average thickness, width, and keystone angle for a wide variety of cable sizes while under the mechanical loading anticipated in the final coil structure. Linear dimensions can be measured to +/- .0001″ and angle to +/- .01°. Cable can be measured with and without insulation. Loading is variable up to 25 ksi. This device has applications in epoxy free coil winding where the cable dimensions must be well understood before coil winding in order to predict the size of the finished coil package. As a diagnostic device, it has application in the cable making process to help understand causes for subtle inconsistencies in cable dimensions. A possible quality control application exists. Current cable quality control requires destructive techniques with very small samplings, usually two samples for 5000′ of cable. Device performance has been evaluated by repeated measurements of lengths of SSC cable.

12113 (BNL—52006, pp 166-168) **Discussion on measurements on superconductors.** Walters, C.R. (Rutherford Appleton Lab., Chilton, England). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The accelerator community has not yet given serious thought to international standardization of data and measurements on superconductors although there was a general feeling that it would be useful. It will, however, require a significant co-ordinated effort if a contribution is to be made in this area. The discussion centered mostly around critical current measurements with the criteria to be used, either resistivity or electric field proving particularly controversial. The n-value is now considered essential data and the critical current should be measured at 10μV/m or 1-$^{-14}$ Omega m.

12114 (BNL—52006, pp 171-174) **Magnet field quality requirements for the SSC.** Chao, A.W. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The question of magnet field quality can be asked in two ways. The direct way is to start with a magnet design, find out the field uniformity that is achieved by the design and then ask if the beam can take the achieved field uniformity. The question can also be asked in a reversed way. One then starts with the fact that the beam needs a good field region (GFR) for its stable operation. The GFR requirement translates into tolerances of field non-uniformity and one then asks if the magnets can make such tolerances. The reverse question is discussed and the SSC design, as presently conceived, is used as an example.

12115 (BNL—52006, pp 175-178) **Reduction of iron saturation in cosine theta dipoles.** Morgan, G. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

It is possible to reduce or eliminate iron saturation effects in high field cosine theta dipoles by putting a large gap between the coil and the iron, but part or most of the field added by the iron will be lost. With a small gap between coil and iron and with sufficient iron on the midplane, iron saturation always occurs first at the poles. Thus to delay saturation onset, it may be sufficient to remove iron near the poles. The RHIC dipole as presently designed is an ideal candidate for a study of possible improvement, since it attains a quench field greater than 4.5 T and has a small gap, about 5 mm, between coil and iron. The coil designed for it, which has 4 blocks of 16, 9, 6 and 3 turns, respectively, is close to perfect at low field. The iron contributes substantial sextupole and decapole at both intermediate and high fields. The moderately large b_2 at 3.44 T can be nulled to first approximation by external trim sextupoles, and the b_4 and b_6 terms add algebraically to 0.1 at 5 = 32 mm. The possible benefits of a shaped iron aperture may arise at higher fields, where b_4 and b_6 don't cancel and b_2 requires substantial correction.

12116 (BNL—52006, pp 179-181) **Field calculation on a strand level for designing future magnets of a small aperture.** Ishibashi, K.; Oae, Y.; Takada, H.; Sakae, T.; Matsumoto, U.; Katase, A.; Hirabayashi, H. (Kyushu Univ., Fukuoka, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The shell type winding has first been utilized for the Tevatron magnets at Fermilab. The simplicity of this winding structure has made it possible to facilitate the winding procedure and to readily control the field quality. The structure is applied to the future accelerator magnets of a smaller aperture in this study. Since the current distribution becomes non-uniform in such magnets, the magnetic field is calculated on the strand level. The strand location in the winding is obtained on the basis of random numbers. Characteristics of the magnet with this winding structure are described in conjunction with its small aperture, which will be require for future accelerator magnets.

12117 (BNL—52006, pp 182-186) **Development of superconducting magnets for accelerators.** Takizawa, T.; Asano, K.; Saito, R. (Hitachi Ltd., Ibaraki-ken, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Recent development of three types of superconducting magnets for accelerator at Hitachi is described. One of which is an accelerator dipole magnet. A high field NbTi/Cu dipole magnet in the 10T region, cooled with pressurized superfluid helium II, was constructed for National Laboratory for High Energy Physics (KEK) in Japan and attained a record maximum field in this kind of dipole magnet. The second of which is a detector magnet, generally a large solenoid. The CDF solenoid had been constructed and was completely installed at the p/sub p vector/ colliding accelerator TEVATRON in Fermi National Accelerator Laboratory (FNAL) in USA. The AMY solenoid which will be installed at TRISTAN in KEK is under construction. Both solenoids are at the world's top class in this kind of solenoid. Recently Hitachi has developed 15T class magnets by using multifilamentary $(NbTi)_3Sn$ conductor. In the near future this kind of high field magnet technology shall be realized to manufacture the future accelerator magnet discussed in ICFA.

12118 (BNL—52006, pp 187-191) **High gradient accelerator quadrupole design.** McInturff, A.D.; Carson, J.A.; Snowdon, S. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

A design study is presented for high gradient quadrupoles based on experimental data for various prototype magnet series that have been fabricated at Fermilab in the last few years. The designs are based on ambient pressure superfluid cooled, solid solution ternary alloys operated at 1.8K - 2.0K at gradients of 2 to 3 T/cm. This design study cites data from a previously developed ternary alloy used in a Tevatron style collared coil magnet operated at 2.0K and to be used in a prototype quadrupole proposed for the SLC final focus. Extrapolated performance is based on an optimized NbTi binary conductor that suggests superior performance can be obtained with the ternary NbTiTa at 2.0K.

12119 (BNL—52006, pp 199-201) **Superconducting cold iron dipole magnet for UNK.** Ageev, A.I.; Andreev, N.I.; Balbekov, V.I.; Dolzhenkov, V.I.; Kashtanov, E.M.; Myznikov, K.P.; Sytnik, V.V.; Tarakanov, N.M.; Tkachenko, L.M. (Institute for High Energy Physics, Serpukhov, USSR). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

IHEP carried on extensive work on simulation of superconducting dipoles for UNK. A series of full-scale warm iron dipoles has been manufactured and tested. The dipoles have exhibited satisfactory magnetic and mechanical characteristics. In 1986, first cold iron magnets of a new design will be manufactured. Their coils will be wound from the cable having a higher current carrying capacity. Their design and basic parameters are described.

12120 (BNL—52006, pp 211-213) **Plans for industrial production of the SSC magnets.** Karpenko, V.N.; Rardin, D.C. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The Universities Research Association through its Central Design Group is currently conducting research and development for the Department of Energy on a superconducting super collider (SSC). The proposed SSC is a device in which protons would be accelerated around a ring approximately 50 miles in circumference. The protons would be kept in their path by means of thousands of powerful superconducting magnets. Two such rings of magnets would be housed in a common underground tunnel, allowing groups of protons to be accelerated in opposite directions and collided, in order to study the fundamental nature of matter and energy. The magnet system is a major element of the SSC in terms of technical requirements, quantity of components and cost. In order to meet technical and production requirements imposed by this system early participation of industry is necessary. The program plans were developed with the objective to involve industry in the early stages of research and development of superconducting magnets, leading to cost effective processes of potential mass production of high quality accelerator magnets by industry. While a decision has not been made by the Department of Energy on whether or not to request construction of the SSC project, if such a request is made and the project is authorized and funded, it would lead to industrial manufacture of a large quantity of superconducting magnets.

12121 (BNL—52006, pp 222-226) **Passive correction of persistent current multipoles in superconducting accelerator dipoles.** Fisk, H.E.; Hanft, R.A.; Kuchnir, M.; McInturff, A.D. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Correction of the magnetization sextupole and decapole fields with strips of superconductor placed just inside the coil winding is discussed. Calculations have been carried out for such a

scheme, and tests have been conducted on a 4 cm aperture magnet. The calculated sextupole correction at the injection excitation of 330 A, 5% of full field, was expected to be 77% effective, while the measured correction is 83%, thus suggesting the scheme may be useful for future accelerators such as SSC and LHC.

12122 (BNL—52006, pp 227-230) **Active internal corrector coils.** Thompson, P.A.; Cottingham, J.; Dahl, P.; Fernow, R.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Hahn, H.; Herrera, J.; Kahn, S. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Trim or corrector coils to correct main magnet field errors and provide higher multipole fields for beam optics purposes are a standard feature of superconducting magnet accelerator systems. Some of the design and construction features of powered internal trim coils and a sampling of the test results obtained are described.

12123 (BNL—52006, pp 233-238) **Requirements of electrical and quench protection systems on magnet design.** Koepke, K. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The electrical circuits of a superconducting accelerator's magnet system consist of the superconducting magnets, the magnet power supply system and the magnet quench protection system, and all three must be optimized together in order to achieve the accelerator's design energy, system reliability and cost effectiveness. How the design of the superconducting magnets and their electric support systems are coupled; the magnet systems which are currently operational or in the planning stage; and their advantages or disadvantages from the perspective of electrical simplicity and reliability are described.

12124 (BNL—52006, pp 239-243) **Study of quench processes in UNK magnets.** Antonichev, G.M.; Glinskiy, M.I.; Gridasov, V.I.; Kaz'min, B.V.; Myznikov, K.P.; Sytnik, V.V.; Vasiliev, L.M.; Yarygin, N.N.; Yerokhin, A.N. (Institute for High Energy Physics, Serpukhov, USSR). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The anticipated quench protection system for UNK magnets is described and the results of experimental study of quench behavior on short and full-scale dipole models are presented.

12125 (BNL—52006, pp 244-245) **Magnet design and construction methods.** Perin, R. (CERN, Geneva, Switzerland). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Magnetic and mechanical design methods for accelerator magnets are discussed. Magnet protection and construction methods are outlined.

12126 (BNL—52006, pp 249-253) **Experience with operating the Tevatron cryogenic system.** Rode, C.H.; Ferry, B.; Fowler, W.B.; Makara, J.; Norris, B.; Peterson, T.; Theilacker, J.; Walker, R. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The start-up of any large system can be broken into three phases: (1) component debug, (2) commissioning and (3) operations. The component debug phase consists of getting the rotating machinery working reliably as well as getting major subsystems operational such as coldboxes. In addition, for computer controlled systems, one must get the control software and a significant fraction of the application diagnostics operational. The 13 years of experience on R & D and operation of the 27 kW Fermilab Tevatron Cryogenic System are described.

12127 (BNL—52006, pp 254-258) **SSC dipole long magnet model cryostat design and initial production experience.** Niemann, R.C.; Carson, J.A.; Engler, N.H.; Gonczy, J.D.; Nicol, T.H. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The SSC dipole magnet development program includes the design and construction of full length magnet models for heat leak and magnetic measurements and for the evaluation of the performance of strings of magnets. The design of the model magnet cryostat is presented and the production experiences for the initial long magnet model, a heat leak measurement device, are related.

12128 (BNL—52006, pp 259-263) **Design of the 4.35 K cryogenic system for SSC.** McAshan, M.S. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The cryogenic system for the conceptual design of the SSC is described. The collider consists of two rings of superconducting magnets some 85 km in circumference. The principal design issues of the SSC cryogenic system are the production of the refrigeration needed for the operational loads, the transport of the refrigeration to all parts of the system, the provision for redundancy and reparability leading to high availability of the system, and the provision for non-steady state operation such as cool-down and quench recovery in a way that provides a suitable operating schedule for the whole facility.

12129 (BNL—52006, pp 264-269) **Central refrigeration system for the superconducting HERA proton magnet ring.** Barton, H.R. Jr.; Clausen, M.; Horlitz, G.; Lierl, H. (Deutsches Elektronen-Synchrotron DESY, Hamburg, West Germany). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The refrigeration system for the superconducting HERA magnet ring is presently being installed at DESY. It consists of three refrigerators and three corresponding compressor groups as well as redundant compressors, oil and water removal systems, cryogenic purifiers, liquid helium dewars and 4000 m^3 of room temperature helium storage capacity. The refrigeration plant which is located in a central refrigerator building and the helium distribution system around the 6336 m long ring tunnel of HERA to supply the superconducting magnets are described. The total capacity of the system is 20.3 kW refrigeration and 61.5 g/s current lead cooling gas rate at 4.3 K as well as 60 kW for the cooling of radiation shields between 40 K and 80 K. The operation of the system will be controlled and automated by a control computer system.

12130 (BNL—52006, pp 270-275) **Preliminary study of a superfluid helium cryogenic system for the large hadron collider.** Claudet, G.; Disdier, F.; Lebrun, P.; Morpurgo, M.; Weymuth, P. (SBT-CEN, Grenoble, France). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

A preliminary study to assess the feasibility of a large hadron collider with dipoles cooled at He II temperature in the LEP tunnel at CERN is described. 10 T NbTi dipoles have to be cooled near 1.8 K taking into account the constraints and the boundary

conditions of an existing tunnel (tunnel size, access pits, etc). This first approach gives an estimation of the heat load and energy consumption. Possible solutions and associated circuitry are analyzed and discussed in the case of the main operating modes resulting from the collider operation.

12131 (BNL—52006, pp 276-279) **Development of cryogenic system for UNK.** Ageev, A.I.; Myznikov, K.P.; Shamichev, A.N.; Tarasov, A.V.; Zhirnov, A.V.; Zinchenko, S.I.; Barmin, N.V.; Butkevich, I.K.; Gorbachev, S.P.; Kovalenko, V.D.; Morkovkin, I.M. (Institute of High Energy Physics, Serpukhov, USSR). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Work on the design and simulation of the cryogenic system for UNK is presently being carried on. A project of such a system specifying the cooling capacity, basic layout and components of the equipment has been drafted for warm iron superconducting magnets. More precise information on the cryogenic system for UNK to be used for cold iron magnets is presented.

12132 (BNL—52006, pp 280-283) **L'Air Liquide's role in the large-scale refrigeration systems required for the next generation of accelerators.** Gistau, G.M.; White, E.G. (L'Air Liquide DTA, Sassenage, France). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The main components of any refrigeration system are: compressors, exchangers, expansion devices, control systems, and in certain cases cold compressors. Compressors and exchangers are easily available from a number of recognized suppliers. However, expansion turbines, cold compressors and dedicated, automatic refrigerator control systems are less readily available, and it is in these areas that L'Air Liquide has specialized.

12133 (BNL—52006, pp 284-287) **Some aspects of the HERA helium refrigerator.** Quack, H. (Sulzer Brothers Ltd., Winterthur, Switzerland). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Large-scale helium refrigerators are needed for experimental setups in high energy physics and controlled nuclear fusion. They are used to cool superconducting magnets and cavities as well as panels for large-scale cryopumping. The refrigerators can take advantage of the same components as developed for the bulk helium liquefiers in connection with the separation of helium from natural gas.

12134 (BNL—52006, pp 288-292) **CEBAF cryogenic system design.** Rode, C.; Brindza, P. (Continuous Electron Beam Accelerator Facility, Newport, NJ). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The Continuous Electron Beam Accelerator Facility (CEBAF) is a standing wave superconducting linear accelerator with a maximum energy of 4 GeV and 200 μA beam current. The 418 Cornell/CEBAF superconducting niobium accelerating cavities are arranged in two 0.5 GeV linacs with magnetic recirculating arcs at each end. There is one recirculating arc for each energy beam that is circulating and any three of the four correlated energies may be supplied to any of the three experimental halls. The cryogenics system for CEBAF consists of a 5kW central helium refrigerator and a transfer line system to supply 2.2 K 2.8 ATM helium to the cavity cryostats, 40 K helium at 3.5 ATM to the radiation shields and 4.5K helium at 2.8 ATM to the superconducting magnetic spectrometers in the experimental halls. Both the 2.2K and the 4.5K helium are expanded by Joule-Thompson (JT) valves in the individual cryostats yielding 2.0K at .031 ATM and 4.4K at 1.2 ATM respectively. The Central Helium Refrigerator is located in the center of the CEBAF racetrack with the transfer lines located in the linac tunnels.

12135 (BNL—52006, pp 293-294) **Discussion on the status of cryogenic technology and future trends.** McAshan, M.S. (Lawrence Berkeley Lab., CA). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The costs of low temperature operation divide into two parts: the costs, both capital and operating, of refrigeration at the lower temperature, and the cost of refrigeration transport. This second in large systems is the greater. The trade-off of cryostat piping size against number of refrigeration stations yields a system with more stations with the loss of economy of scale, and with higher costs. This is apparent in the preliminary studies for the 1.8 K system for the LHC in which eight stations are proposed. The studies for the 2 K operation of the SSC reached a similar conclusion. There 24 or 32 stations are proposed in a ring three times as large. It is likely that a system employing distributed first stage cold compressors and relatively fewer refrigeration stations will be closer to the cost optimum. The development effort in cold turbocompressors should not, therefore, concentrate on large capacities only. The status of cryogenic technology is discussed and future trends are summarized.

12136 (BNL—52006, pp 297-301) **Fundamentals of magnetic measurements with illustration from Fermilab experience.** Brown, B.C. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Techniques for measurement of magnets used in accelerators and beams are discussed with emphasis on principles and limitations of the various techniques. Selection of parameters to measure, mechanical, electronic and data collection issues is discussed. Illustrations are primarily selected from the experience in measuring more than 1200 superconducting and more than 600 conventional magnets for the Tevatron at Fermilab.

12137 (BNL—52006, pp 302-308) **Production techniques for measuring SSC accelerator magnets.** Wanderer, P. 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Plans for the formidable task of measuring SSC accelerator magnets are reviewed. The focus is on measurements of the dipoles for the two collider rings. The magnitude of the job is summarized. The required accuracy of the measurements is discussed in terms of SSC accelerator requirements and expected magnet production tolerances. The measuring system which will be used for the first 16.6 m SSC dipoles is described.

12138 (BNL—52006, pp 309-311) **Magnetic field measurement with NMR imaging.** Gross, D.A. (General Electric Co., Schenectady, NY). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

It is proposed that accelerator magnet field quality measurements be performed by the well-developed techniques of magnetic resonance imaging (MRI), which have a high degree of resolution both spatially and in detectable inhomogeneity. The absolute and high accuracy of nuclear magnetic resonance (NMR) is an attractive feature that has only been utilized in point measurements. MRI expands NMR measurements to volumes and can cover long accelerator dipoles piecewise.

12139 (BNL—52006, pp 312-314) **Accelerator magnetic measurements.** Mantsch, P. (Fermi National Accelerator Lab., Batavia, IL). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The fundamentals of magnetic measurements, the Tevatron measurement experience, measurement techniques for SSC magnets and the measurement program for the HERA superconducting dipoles are reviewed. The important measurement issues are discussed and in particular problems related to quality control of the production of large numbers of magnets in industry are described. The precision required and the precision possible in the measurement of the new smaller (<5 cm) aperture accelerator magnets are crucial considerations in planning machines like SSC and LHC.

12140 (CONF-851268—, pp 91-101) **Accelerator based steady state neutron source.** Burke, R.J.; Johnson, D.L. (Rockwell International Rocketdyne Div., Canoga Park, CA). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

Using high current, cw linear accelerator technology, a spallation neutron source can achieve much higher average intensities than existing or proposed pulsed spallation sources. With about 100 mA of 300 MeV protons or deuterons, the accelerator based neutron research facility (ABNR) would initially achieve the 10^{16} n/cm^2s thermal flux goal of the advanced steady state neutron source, and upgrading could provide higher steady state fluxes. The relatively low ion energy compared to other spallation sources has an important impact on R and D requirements as well as capital cost, for which a range of $300-450 M is estimated by comparison to other accelerator-based neutron source facilities. The source is similar to a reactor source is most respects. It has some higher energy neutrons but fewer gamma rays, and the moderator region is free of many of the design constraints of a reactor, which helps to implement sources for various neutron energy spectra, many beam tubes, etc., with the development of a multibeam concept and the basis for currents greater than 100 mA that is assumed in the R and D plan, the ABNR would serve many additional uses, such as fusion materials development, production of proton-rich isotopes, and other energy and defense program needs.

12141 (CONF-851268—, pp 102-115) **CW accelerators suitable for spallation neutron sources.** Chidley, B.G. (Chalk River Nuclear Labs., Ontario). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

An accelerator-driven steady state neutron source will require a high current, high energy, 100% duty factor accelerator. No suitable accelerator has yet been built, but the technology to do so exists and examples of all of the likely components have been tested. This paper reviews some of the component test programs with comments on the problems specific to this application.

12142 (CONF-851268—, pp 116-122) **Neutronics of SINQ, a continuous spallation neutron source.** Fischer, W.E. (Swiss Institute for Nuclear Research, Villigen, Switzerland). 15 Aug 1986. Elsevier Science Publishers B.V., P.O. Box 211, 1000 AE Amsterdam, The Netherlands. File Number TI87000306.

From Workshop on an advanced steady state neutron facility; Gaithersburg, MD, USA (16 Dec 1985).

The paper gives a short technical description of the principles of SINQ, the reference design of which is based on neutronics investigations at various mock-up systems. The author presents some of these experimental results and the corresponding performance which can be expected from this neutron source.

12143 (DOE/ER/05940—T2) **Design of gyrotron amplifiers for driving 1 TeV e^-e^+ linear colliders.** Granatstein, V.L.; Vitello, P.; Chu, K.R.; Ko, K.; Latham, P.E.; Lawson, W.; Striffler, C.D.; Drobot, A. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). 1984. Contract AS05-78ER05940. 4p. NTIS, PC A02. File Number DE87003768.

The suitability of 10 GHz gyroklystron amplifiers for driving e^-e^+ super-colliders is being studied. First, an experiment will be carried out to demonstrate peak power of 30 MW together with high gain, good efficiency, and low phase jitter. Second, extrapolation to 300 MW is anticipated. The present paper presents designs for both 30 MW and 300 MW based on 500 keV electron beams and symmetric TE/sub 0n/ modes in circular gyroklystron cavities. Stable amplifier operation is expected, since the current is well below the threshold for exciting oscillation in the cavities, and the drift spaces are designed to heavily load the modes which are not cutoff.

12144 (DOE/ER/05940—T5) **Accelerator research studies: Progress report, Task C.** (Maryland Univ., College Park (USA)). Jun 1985. Contract AS05-78ER05940. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003344.

The major effort reported is the study of the feasibility of a 300 MW gyroklystron at ~9 GHz, and substantial progress has been made. A four-cavity gyroklystron design has been shown to be capable of linear gain as high as 66 dB and to be marginally stable against oscillation in any mode. AM and PM sensitivities to fluctuation in system parameters have also been calculated in the regime of linear operation. Initial non-linear design calculations have also been carried out which include the effect of tapering the axial magnetic guide field over the length of a gyroklystron circuit. Although these calculations are preliminary they do indicate potential for significant efficiency enhancement by magnetic field shaping techniques.

12145 (DOE/ER/10742—5) **Development of an x-ray beam line at the NSLS for studies in materials science using x-ray absorption spectroscopy: Annual progress report.** Sayers, D.E. (North Carolina State Univ., Raleigh (USA). Dept. of Physics). [1986]. Contract AS05-80ER10742. 51p. NTIS, PC A04. File Number DE87003918.

Although only in operation since May, 1985, the X-11 participation research team (PRT) at the NSLS has already demonstrated that it is one of the leading centers of x-ray absorption spectroscopy (XAS). During this time, results have been obtained and programs initiated in a number of areas, for example: interfaces, including deposited metal-metal and metal-semiconductor systems, multilayers and ion implanted layers; electrochemical systems, including Pt electrode fuel cells, Ni oxide battery electrodes, conducting polymers, passivation and corrosion; catalysts, including highly-dispersed supported metal catalysts and zeolite systems; quasi-crystals, heavy fermion systems, uranium and neptunium compounds, rare gas clusters, disordered metals and semiconductors, ferroelectric transition; and, biological systems and related models, including synthetic porphyrins and a number of metalloproteins. In concert with these scientific results have been a number of developments involving the technique itself. These include implementation of unique optical systems on both the A and B lines for optical performance over their designed energy ranges, advances in experimental capability, particular in glancing angle studies, optimization of ion chambers for surface studies, the improvement of electron yield detectors, and improved software for data acquisition and analysis. This report emphasizes some of the research highlights and significant developments of our PRT which occurred during the past year. A detailed bibliography of papers and talks resulting from work done at our beamline and the progress reports for our PRT which were in the 1985 NSLS Annual Report are appended.

12146 (DOE/ER/40124—11) **The vacuum system of the University of Washington Booster-Linac.** Amsbaugh, J. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). Nov 1986. Contract AC06-84ER40124. 3p. (CONF-8611103—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003133.

From 20. symposium of North Eastern Accelerator Personnel; Notre Dame, IN, USA (3 Nov 1986).

The Linac-Booster vacuum system provides insulating vacuum for 12 accelerator and 2 buncher cryostats and evacuates the beamlines that transport the beam to and from the linac. Turbomolecular pumps (TMP) are used in the system. The TMP pumping stations are described, and the performance of the system is discussed. The system is monitored and controlled by a vacuum satellite computer communicating with a main control computer. The control hardware and software are described. (LEW)

12147 **(FNAL-TM—1429) Report of the Census Task Force on beamline control system requirements.** Barsotti, E.J.; Bartlett, J.F.; Bogert, V.D.; Borcherding, F.O.; Butler, J.; Czarapata, P.C.; Spalding, W.J.; Thomas, A.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 2 Oct 1986. Contract AC02-76CH03000. 121p. NTIS, PC A06. File Number DE87003967.

A special task force was appointed to study the experience with the present beamline control system at Fermilab and to make recommendations in this area. The charge of the committee and the list of its members are appended. In order to carry out its assignment, the committee conducted a series of meetings in which it discussed the controls situation in general and the best way to approach the user community. The various groups of users were identified, and a letter was written to representatives of these groups asking questions concerning the present system and future needs. The committee met with each group to discuss the response to these questions. Written summaries of the discussions are appended. Conclusions are drawn regarding current problems, systematic upgrades and specific recommendations. (LEW)

12148 **(FNAL-TM—1431) Muon calculations for the polarized proton beamline.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1986. Contract AC02-76CH03000. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003783.

Monte Carlo calculations of the muon intensities due to the new polarized proton beam using the program CASIM are reported. Results are reported in terms of tissue absorbed dose per incident proton. (LEW)

12149 (INIS-SU—369, pp 39-42) **Li, C and Mg nuclei acceleration in the JINR synchrophasotron from the CO_2 laser ion source.** Beznogikh, Yu.D.; Bonch-Osmolovskij, A.G.; Govorov, A.I.; Zinov'ev, L.P.; Kulikov, I.I.; Monchinskij, V.A.; Pikin, A.I.; Semenyushkin, I.N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of investigations into Li, Ca and Mg nucleus acceleration at the JINR synchrophasotron from a laser source based on the CO_2 laser with ultraviolet preionization having 10 J output energy at 1 Hz repetition frequency are given. Intensities of nuclei accelerated in the synchrophasotron up to 4.2 GeV/nucleon were as the following: sub(6)Lisup(3+) - approximately 10^8 nucleus/pulse, sub(7)Lisup(3+) - approximately 2 x 10^9 nucleus/pulse, sub(12)Csup(6+) - approximately 5 x 10^8 nucleus/pulse and sub(24)Mgsup(12+) - approximately 10^5 nucleus/pulse. It was discovered that after crater formation in targets the number of ions and their charging increase. Processes related to this phenomenon were considered. Numerical estimations of electron density and temperature on the crater axis permitted to obtain values nsub(c)=5 x 10sup(19) cmsup(-3) and Te approximately or equal to 400 eV. The results obtained clear the way for using and furtherdevelopment of the CO_2 laser sourse and the observed "crater effect" can be used for increasing multicharged ion yield.

12150 (INIS-SU—369, pp 212-214) **Electron gun - the LIU-5/5000 induction linac injector.** Martynov, S.V.; Pershin, V.I.; Popova, N.Ya.; Vakhrushin, Yu.P.; Kolesov, N.I.; Mamykin, V.N.; Popov, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki; Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The description of an improved electron gun (EG) - the LIU-5/5000 induction linac injector - is presented. EG consists of three main units: two pulse transformers (cathode and anode) and cathode assembly. A desorption-slit cathode is used in EG. The cathode tests have shown, that when the gap is 35 mm it ensures 3 kA stable current at the voltage 400 kV. Emittance value equalled 0.2 cm x rad for 80% beam. The cathode operated faultlessly for a quarter of a years and its total operating efficiency constituted 2 x 10^5 pulses.

12151 (INIS-SU—369, pp 49-52) **Coherent oscillations of ribbon beams in periodical transport channels.** Zenkevich, P.R.; Korolev, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

To investigate coherent instability of high-current beams for a ribbon beam moving in a homogeneous linear focusing field,a system of second order homogeneous integral equations has been derived. Its analysis for a particular case of beams with constant particle density in phase space has been performed. Dependence of coherent frequences on the Coulomb load value (eta) is given. Dependence of sextupole mode parametric resonance on eta increment is given as well.

12152 (INIS-SU—369, pp 61-64) **System for simultaneous extraction of two gamma beams on the fast-cycling electron synchrotron.** Zapol'skij, N.A.; Markar'yan, A.A.; Nikogosyan, V.Ts.; Simonyan, Kh.A.; Tumanyan, A.R. (Erevanskij Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A system of simultaneous extraction of two gamma beams at the Erevan synchrotron is described. The extraction is carried out from two neighbouring focussing gaps of the synchrotron. To carry out such an extraction of beams the method of double (radial and vertical) beam guidance on each target is developed, and different variants of local radial guidance of the beam simultaneously on two-three internal targets of the synchrotron with magnetic structure of the FOFDOD type are studied and considered. The variants are based on the "beam-bump" disturbance of the accelerator guiding magnetic field. Adjustment of the system while changing the synchrotron operation regimes necessitates not more than half an hour, and transition to the old "traditional" system of bumps necessitates time only to commutate two switches. Putting the system into operation increased efficiency of accelerator use by two times during the operation of internal targets.

12153 (INIS-SU—369, pp 276-279) **Bending magnet edge field nonlinear effects in cyclic accelerators and storage rings.** Bulyak, E.V.; Efimov, S.V.; Tarasenko, A.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

It is known that bending magnet edge fiels decrease axial focusing and axial betatron oscillation frequency. The aim of the study is to consider resonances excited by edge fields, to determine

amplitude-frequency characteristics of betatron motion, and to estimate edge field effect on the process of slow extraction of particles from an accelerator. The vector potential of a dipole magnet edge field is found; it is shown that in case of a plane magnet the edge field is completely described by the function determining an axial component in a median plane. The amplitude-frequency characteristics of betatron oscillations are found on the base of Hamiltonian formalism; it is shown that the edge field doesn't effect the nonlinearity of radial oscillations. Types and forces of resonances excited by the edge field are found. Comparison of the theoretical results obtained with the experimental data shows good agreement. Conclusions about essential draw backs during beam extraction in the axial plane, if compare with aradial one, are made. It is caused, firstly, by the presence of relatively high nonlinearity stabilizing the resonance of slow extraction. It will lead to increase of particle losses in septum magnet and to increase of extracted beam emittance.

12154 (INIS-SU—369, pp 289-291) **Computer simulation of relativistic electron slow extraction from a storage ring-stretcher with account of radiation effects.** Grigor'ev, Yu.N.; Kononenko, S.G.; Mazmanishvili, A.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Calculation of electron motion in a storage-stretcher (SS) with real characteristics offers great difficulties for the theory. In this connection the computer program RADA was developed; which makes possible to carry out real time simulation of particle motion in SS in the hexaphase space, taking into account the coupling between oscillations and radiation effects. It makes also possible to study oscillation damping; caused by radiation, as well as fluctuations of transverse momentum and energy at the slow particle extraction from SS.

12155 (INIS-SU—369, pp 298-302) **Estimation of the role of the reaction of μ^--capture by iron nuclei in the formation of neutron field around a muon absorber of the U-70 neutrino channel.** Kryuchkov, V.P.; Semenova, G.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The aim of the paper is to evaluate levels of low-energy ($E<10$ MeV) neutrino radiation fields due to negative muon absorption by nuclei of radiation protection material and the iron muon absorber of a secondary particle channel. The conclusions were made that neutrons from μ^--capture by iron nuclei, can play a significant role in forming neutron radiation field around the muon absorber irrelatively to intensity of an incident beam. Basing on the technological reasons, the muon absorber is usually made of iron and it is not screened outside by hydrogen-containing material. In this case neutrons from μ^--capture will be the main source of stray radiation. Dose rate levels determined by a low-energy neutron component will exceed 10 times the control values when neutrino channel of the Serpukhov accelerator operating, which has been taken as an example with the intensity of 10^{13} proton/cycle in the mode of focusing of negative particles on the muon absorber surface at the distance of 12 m from the start of the absorber.

12156 (INIS-SU—369, pp 303-308) **Calculation of radiation and background conditions on the IHEP tagged neutrino channel.** Bajshev, I.S.; Bugorskij, A.P.; Denisov, S.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of calculations of particle distributions in the tagged neutrino channel in IHEP optimized for equilibrium pulse of 35 GeV/c positive charged particles are presented. The results are normalized for a proton impinging the target of 70% efficiency. Special collimator system decreasing hadron fluxes on the surface of a decay tube is calculated. The necessary thickness of concrete protection from 10 MeV hadrons does not exceed 1 m. The conducted calculations promoted optimum choice of hadron and muon protection of the channel, determination of parameters and design of collimators, solution of background problems for the tagged station and for neutrino detector.

12157 (INIS-SU—369, pp 309-313) **Time analyzing system for neutron secondary radiation in an accelerator cycle.** Belogorlov, E.A.; Britvich, G.I.; Krupnyj, G.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of implementation in IFVEh of the system for spectral time analyzing of neutron radiation to store and accumulate information, from the Bonner spectrometer are presented. The system is constructed in the VEKTOR standard and it operates in complex with the UNO-4096 pulse analyzer and the SM-4 computer.

12158 (INIS-SU—369, pp 68-71) **Ways for improvement of design solutions for experimental areas of high-energy accelerators.** Getmanov, V.B. (Moskovskij Inzhenerno-Stroitel'nyj Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Possibilities of the reduction of specific consumption of shielding materials, the increase of efficiency of the use of areas in experimental rooms and efficiency of design solutions for experimental zones of high-energy charged particle accelerators are considered. Reduction of the specific consumption of shielding materials can be achieved by three ways: by the use of more effective shielding materials, decrease of the distance between shielding and the source, increase of admissible levels of irradiation on the external surface of the shielding. Disadvantages of traditional solution for experimental room construction are shown. It is proposed to use the enclosure constructions as the shielding of magnetic optics channels without the building of experimental room itself. Such a solution permits to reduce the expenditures on the building of accelerator complex and the dates of accelerator building.

12159 (INIS-SU—369, pp 108-110) **Radiation field shaping systems in accelerators for radiation engineering.** Ivanov, A.S.; Ovchinnikov, V.P.; Svin'in, M.P.; Fedotov, M.T. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A radiation field shaping system with stationary field long bending magnet (BMSS) positioned directly before the output window along the beam path paralelly to the accelerator axis, is described. Various circuitries of 0.2-10 MeV high-voltage accelerations with BMSS are presented. BMSS has been used at "Aurora-4" accelerator for radiation-chemical local and homogeneous modification of rolled materials. The use of BMSS in this accelerator has permitted to decrease its hight and weight more than two times in comparison with traditional radiation field shaping system. Main parameters of the "Aurora-4" are presented.

12160 (INIS-SU—369, pp 111-113) **Magneto-optics for linear electron accelerator with beam recirculation for radiotherapy.** Nagaenko, M.G.; Severgin, Yu.P.; Fedorov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad, USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Magneto-optical devices of the 40 MeV LUEhR-40M accelerator designed for radiotherapy, are described. A magnetic mirrow and bending-shaping device are reffered to magnetooptical systems. The both devices do not contain quadrupole lenses and have only dipole magnets with radial-homogeneous field. Axial focusing of particles is carried out by magnetic field boundary skew. The both devices have internal mirror symmetry. Results of optimization of devices parameters with the help of BETRAMF program are presented.

12161 **(JINR—16-85-710) Calculation of absorbed dose radial distribution at an incidence of light nuclei at 1 mrad angle onto the iron target.** Zajtsev, L.N.; Syrejshchikov, A.E.; Reshetnikov, G.P.; Kvostov, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Moskovskij Inzhenerno-Fizicheskij Inst. (USSR); Institut Mediko-Biologicheskikh Problem, Moscow (USSR)). 1985. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700455.

Calculations of the radial dose distributions in a "window frame" type dipole magnet were carried out; the distributions arise at an incidence of light relativistic nuclei at 1 mrad angle onto the aperture walls. A set of programs based on the cascade-evaporational model of nuclear-nuclear interactions is used to carry out the ca culations. For the light nuclei with approximately 1 GeV x nuclsup(-1) energies the absorbed dose in a layer of upto 4g x cmsup(-2) thick is formed by the ionization losses of primary nuclei, by the proton-meson component of a internuclear cascade and by fragments of a projectile and target-nucleus. The obtained radial distributions can be used for estimation of over heating in accelerator dipole magnet coils at the light nucleus impinge at asub(E)=1 mrad angle onto the ion guide wall. 10 refs.; 6 figs.

12162 **(LBL—21294) 1.8K conditioning (non-quench training) of a model SSC dipole.** Gilbert, W.S.; Hassenzahl, W.V. (Lawrence Berkeley Lab., CA (USA)). Sep 1986. Contract AC03-76SF00098. 7p. (CONF-860914—18). NTIS, PC A02. File Number DE87002565.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

The accepted hypothesis is that training quenches are caused by heat generation when conductors move under Lorentz force. Afterwards no conductor motion will occur until a higher field and greater Lorentz force acts. If superior heat transfer and/or greater temperature margin is provided by operating at lower bath temperature, one might expect that the heat generated by conductor motion will not cause a runaway temperature increase, or quench. To test this hypothesis, the central dipole field in SSC model magnets was ramped at 1.8 K to 7.1 tesla without the magnets' quenching. The bath was then raised to 4.4 K and the magnets quenched at their short sample limits of 6.6 tesla or higher. Comparison with similar magnets trained in He I at 4.4 K is made and the significance of the non-quench training on system operation is discussed.

12163 **(TRI-PP—86-89) H^- extraction and proton accumulation for the TRIUMF KAON factory synchrotron project.** Mackenzie, G.H. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 8p. (CONF-8610173—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900302.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

The troposed TRIUMF KAON factory accelerator complex includes the accumulation of the cw cyclotron beam in an appropriately designed storage ring. Ions accumulated over 20 ms would be transferred to a rapid cycling, 50 Hz, booster synchrotron in one turn. The most appropriate method to fill the accumulator ring is by charge exchange injection, $H^- \rightarrow H^+$, together with so programming the incoming beam energy and direction and the ring closed orbit location that precessional motion fills the acceptance with a broad smooth distribution. The results of computer simulations are presented. An experimental program has successfully demonstrated the feasibility of efficient extraction of 450 MeV H^- ions from TRIUMF. Spill on the septum of an electrostatic deflector is eliminated by a thin stripping foil placed upstream. The extraction efficiency is increased by generating a coherent radial oscillation at nu/sub r/ = 3/2 by means of a radial rf field. A 10 mm space between deflected and circulating beams was measured at the location of a planned magnetic channel; the deflector/foil transmission was 85%.

12164 **(TRI-PP—86-90) High level extensions to the TRIUMF central control system.** Dohan, D.A.; Mouat, M.M. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 4p. (CONF-8610173—10). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900312.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

The TRIUMF central control system "CCS" consists of a system of 16-bit minicomputers connected to cyclotron equipment by means of a multi-branch parallel highway CAMAC system. Because these computer "sources" are programmed primarily in assembler language, there are difficulties in carrying out complex or precise numerical algorithms. Recently, a limit to the maximum number of sources with access to the CAMAC hardware has been removed and several VAX computers have been added. The configuration has very conveniently allowed independent development of data acquisition and analysis software, and has permitted the implementation of mature accelerator physics software developed elsewhere. The new VAX sources incorporate the use of sophisticated system software, multiple high-level languages, graphics, networking and an independent CAMAC highway. A separate serial CAMAC highway supports cyclotron development without compromising the on-line duties of the existing central control system. This paper describes the new configuration and the implementation of the data acquisition and analysis software.

12165 **(TRI-PP—86-93) An intense ion source for H^- cyclotrons.** Baartman, R.; Kendall, K.R.; MacDonald, M.; Mosscrop, D.R.; Schmor, P.W.; Yuan, D.; Olivo, M. (TRIUMF, Vancouver, British Columbia (Canada); Schweizerisches Inst. fuer Nuklearforschung, Villigen). Oct 1986. 4p. (CONF-8610173—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900314.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

An H^- ion source, employing multicusp plasma confinement and a magnetic filter to enhance volume H^- production, has been developed for the TRIUMF cyclotron. The source was designed to operate in a dc mode, to have a long filament lifetime and to provide an intense H^- beam of low emittance. Unlike the PIG ion source, the emittance could be easily scaled without affecting the current density to match the acceptance of the cyclotron. The source design, operating characteristics, beam quality measurements and initial operating experience with the TRIUMF cyclotron are described.

12166 **(TRI-PP—86-97) A high-power target system for radioisotope production.** Burgerjon, J.J.; Gelbart, Z.; Hendry, G.O.; Lofvendahl, J.C.; McIlwraith, L.; Pinto, G.A. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 4p. (CONF-8610173—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900308.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

To utilize the powerful external beams, available from H^- cyclotrons, a high-power, target system was designed by The Cyclotron Corp. of Berkeley, CA and further developed at TRIUMF. The system consists of two target stations served by beam lines from a 42 MeV cyclotron (CP-42) and a pneumatic "rabbit" system that transfers the targets to the radio chemistry hot cells. The targets can accept a 28 MeV proton beam of 200 μA, while the target surface temperature is kept below 150°C. The system has been in operation for three years for the production of radioisotopes for the AECL Radio Chemical Co. This paper describes the system with the Mark II version of the target stations. The whole system has been in operation for over three years. The Mark II target stations have been in operation for over one year and are particularly trouble free and easy to operate and service.

12167 **(TRI-PP—86-107) Status of the TRIUMF optically pumped polarized H^- ion source.** Law, M.; Levy, C.D.P.; McDonald, M.; Schmor, P.W.; Uegaki, J. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 3p. (CONF-8610115—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE87900304.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The optically pumped polarized H^- ion source at TRIUMF is capable of producing ≃10 μA of H^- at a polarization of ≃65%, within a normalized emittance at the 60% contour level of 0.4 II.mm.mrad for an ionizing field of 1.5 kG. Installation of the ion source on the TRIUMF cyclotron has begun and is scheduled to be completed by the end of 1987.

12168 **Vacuum pulse conditioning and risetime sharpening on a low nu/gamma multi-MEV electron beam accelerator.** Stringfield, R.M.; Bartsch, R.R.; Davis, H.A.; Sherwood, E.G. (Physics Div., Los Alamos National Lab., Los Alamos, NM 87544). pp 36 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—).

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

The surface flashover switch interrupts the cathode stalk of the vacuum transmission line near the load. The flashover voltage is controlled by varying the switch length, with a maximum flashover voltage of 3MV. A diode element immediately upstream of the switch allows current to build up in the inductance of the vacuum transmission line while the switch is open. Upon switch closure, the axial current flowing the the load acts as a bias current to magnetically inhibit current flow in the upstream diode. This diode serves the additional purpose, with or without the flashover switch, of diverting a controlled portion of the total machine current form the load by varying the AK spacing. This feature provides the capability to vary the current and voltage at the load outside the simple constraints of the accelerator's load line. An examination of the performance of the switch and the diode is presented.

12169 **Possibilities for studying short-lived nuclei produced at LAMPF.** Talbert, W.L. Jr.; Bunker, M.E. (Los Alamos National Lab., Los Alamos, NM). pp 1303-1307 of Nuclear data for basic and applied science. Volume 2. Young, P.G.; Brown, R.E.; Auchampaugh, G.E.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The authors present results of a study of the feasibility of using a He-jet coupled on-line mass separator system at LAMPF. He-jet transport-line characteristics, and estimates for the production of nuclei far from stability are given. Some specific areas of interest for potential studies are also presented.

12170 **Enhanced 200 GeV/c K^+ beam using beryllium filter.** Jonckheere, A.; Nelson, C.; Collick, B.; Heppelman, S.; Makdisi, Y.; Marshak, M.; Peterson, E.; Ruddick, K.; Berg, D.; Chandlee, C.; Cihangir, S. (Fermilab, Batavia, IL). *Nuclear Instruments and Methods in Physics Research;* **180**: 25-28(1981).

Using beryllium as a selective hadron filter, the kaon fraction of a positively charged 200 GeV/c secondary beam has been increased from 3% to ~15% without an appreciable effect on tagging efficiency.

4304 Storage Rings

REFER ALSO TO CITATION(S) 11623, 12153, 12621, 12689

12171 (BNL—52006, pp 192-194) **Development of superconducting dipoles and construction of prototypes for HERA at Brown Boveri and Company (BBC).** Foerster, M. (Brown, Boveri and Co., Mannheim, West Germany). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

More than 400 9 m long superconducting dipole magnets are required for the HERA proton storage ring. These magnets have to be built by the industry in the next two years. During the last 5 years construction methods for large magnets have been worked out as preparation for the mass production.

12172 (BNL—52006, pp 195-198) **Superconducting quadrupoles for HERA.** Auzolle, R.; Le Marrec, P.; Patoux, A.; Perot, J.; Rifflet, J.M. (C.E.N./SACLAY, Gif-sur-Yvette, France). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The superconducting quadrupoles of the HERA machine have been designed and built at the Saclay Laboratory. Since 1981 four prototype quadrupoles have been built and successfully tested in a bath cryostat. The two first magnets built are of the warm iron type and mounted in a 2 meter long cryostat. These cryostats were tested 2 years ago at DESY. The two other magnets are of the cold iron type and are being mounted in a 4 m long cryostat. This cryostat contains many other items such as: a correction dipole with its 50 A current leads, a beam monitor, a protection diode, a vacuum barrier for the cryogenic vacuum and safety tubes for both the pressurized and boiling heliums. These cryostats are nearly completed and work to build the series magnets should start by the end of 1986. The main characteristics of the magnets and some construction details are given.

12173 (BNL—52006, pp 202-206) **Construction of superconducting quadrupole magnet.** Ito, S.; Nakazawa, J.; Murai, S.; Hirano, M. (Toshiba Corp., Yokohama, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Based on the design of the superconducting insertion quadrupole magnet built for the TRISTAN Main Ring in KEK, a prototype superconducting quadrupole magnet was newly fabricated, which consists of a four-layer coil having a 140 mm inner diameter and 217 mm outer diameter, and stainless steel collars surrounding the coil to clamp it firmly. And, now, the construction of this new magnet as well as its evaluation test is completely finished. The coils consist of two layers of Rutherford type cable made from 27 strands of Nb-Ti, and of copper cable (outer two layers). Insulation spacers attached at coil ends have a unique form made by machining using a 5-axis NC machine so that there is no gap between spacers and conductors. The reasonability of construction of this new magnet was successfully examined by field measurement in a room temperature state and at lower current as well as checking the dimensional accuracy. The construction of this magnet is described.

12174 (BNL—52006, pp 207-210) **VENUS superconducting thin solenoid magnet.** Satow, T.; Wake, M. (Mitsubishi Electric Corp., Kobe, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The VENUS solenoid magnet was constructed, and tested successfully at KEK on February 1986. The magnet has a warm bore diameter of 3.4 m, an outer diameter of the cryostat of 3.8 m, and a total length of the cryostat of 5.6 m. It is the largest one at present of several thin solenoid magnets for colliding beam detectors, and furthermore it has a very short radiation thickness of 0.52. For the purpose of better cooling, Kapton insulators between the coil-case and the winding were cured under expansion pressure, and the helium shield of 2 mm thick aluminum cylinder was set up inside the coll. The conductor jointing method without extra space in the winding was invented to obtain a uniform magnetic field distribution, and an aluminum stabilized NbTi-Cu conductor of 10 km unit length was fabricated. The magnet was first cooled and excited to 2000 A without an iron yoke at the factory. It was assembled with the iron yoke at KEK, and cooled to 4.6 K in 14 days. The first excitation to the rated current of 3978 A was performed without quench. The magnetic field was 0.75 T. Several forced quench tests were made to investigate the stability of the magnet and to check the safety of operation.

12175 (BNL—52006, pp 217-221) **S.C. correction coils and magnets for the HERA proton ring.** Daum, C.; Geerinck, J.; Moeller, H.; Heller, R.; Schmueser, P.; Bracke, P. (NIKHEF-H, Amsterdam, Netherlands). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

The quadrupole and sextupole correction coils of the HERA proton ring are mounted on the cold beam pipe inside the main dipole magnets. Superferric dipole magnets for orbit correction are located adjacent to the main quadrupole magnets in a common cryostat which also contains the beam monitor. The design, manufacture and performance of both types of correction elements are described.

12176 (INIS-SU—369, pp 34-38) **Low of formation of accelerating voltage frequency change in the IHEP ring booster injector.** Bruk, V.L.; Vorob'ev, V.K.; Klimenkov, E.V.; Mamuchashvili, N.G.; Tishin, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Block-diagram of a new section for accelerating field frequency formation in the ring injector - the IHEP booster is described. To obtain the effective tuning range of 0.7-2.8 MHz, heterodyne method with two controlled oscillators was used. Two oscillators are connected in the same circuit, their circuits have similar inductance coils and are placed into an aggregate thermostat. Block-diagrams of a master oscillator, an initial frequency oscillator and a function converter are given. Digital control application permitted not only to improve main section characteristics but to gain new possibilities for using computers. Control program provides work with equipment, dialogue with an operator, and a specialized operational system provides regime rescuing and restoration.

12177 (INIS-SU—369, pp 206-208) **Beam heating near the threshold of low-dissipative instability.** Dikanskij, N.S.; Pestrikov, D.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Dynamics of a beam heating in a storage ring near the threshold of low-dissipative instability is considered. The case when instability of a monoenergetic beam is caused by a low dissipation of electrodes surrounding the beam is analyzed. It is shown, that in the process of stabilization of coherent instabilities by the Landau damping the beam can not be cooled to the temperatures below the threshold ones. This is related with the increase of a beam coherent noise power with approaching the instability threshold and this is a common feature for all coherent instabilities of a beam. The heating in the near-threshold region can be the reason for an increase in the beam length, which is formed in a bunch by the storage ring HF field.

12178 (INIS-SU—369, pp 246-249) **Peculiarities of Coulomb relaxation of a cold nonbunched beam in a storage ring.** Dikanskij, N.S.; Pestrikov, D.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Peculiarities of Coulomb relaxation of energy distribution of a cold non-bunched beam in a storage ring are considered. In adiabatic limit particle collisions are replaced by collisions of charged dices, the radii of which are determined by betatron oscillation amplitudes.

12179 (INIS-SU—369, pp 258-261) **Measurement of spin frequency spread in a storage ring.** Lysenko, A.P.; Polunin, A.A.; Shatunov, Yu.M. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of experiments on measurement of spin frequency spread at the VEPP-2M storage ring are presented. Depolarization time at coherent spins flig due to external HF-field effect was measured. The determined value of spin frequency spread in the working variant of the VEPP-2M magnetic structure made up 2π x 35 ssup(-1). Comparison of measured values with calculated value for the linear case reveals that contribution of storage ring non-linearities is determinant for spin frequency spread which can be reduced at the expense of correct choice of nonlinearity corrections.

12180 (INIS-SU—369, pp 268-271) **High-energy quasimonochromatic and Compton polarized γ-quanta source for nuclear physics experiments on the VEPP-4.** Kazakov, A.A.; Kezerashvili, G.Ya.; Skrinskij, A.N.; Tumajkin, G.M.; Shatunov, Yu.M.; Lazareva, L.E.; Nedorezov, V.G. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki; AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The BSCQ facility (back-scattered compton quanta) is developed on the basis of the VEPP-4 laser polarimeter. The "INNOVA-20" laser system is a photon source. Linear polarization of laser photons is transformed by means of the Porkels thermostabilizing cell in any assigned polarization. The experimentally attained counting rate of γ-quanta in the BSCQ facility equals 10^5 plot./s at 10 mA current of an electron beam circulating in the storage ring. Coordinate and energy distributions of a beam of compton γ-quanta with detection threshold of 212 MeV are presented. Experiments on measuring cross sections of transuranium nuclei photofission by γ-quantum of intermediate energies as well as experiments on clarification of mechanisms of electromagnetic interaction of heavy nuclei are carried out at the BSCQ facility.

12181 (INIS-SU—369, pp 280-284) **Effect of a cubic nonlinearity of storage ring guide magnetic field on colliding effects.** Temnykh, A.B. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The paper deals with study of the effect of zero harmonic of cubic nonlinearity of storage ring guide magnetic field on motion of a particle interacting with a colliding beam. The colliding bunch is considered infinitely short. Synchrotron motion of particles, radiation effects were not taken into account. Only radial motion was considered. It is shown that at positive cubic machine nonlinearity there exists region where negative "cubic" beam nonlinearity is

compensated by positive one, and amplitude pulsations of betatron oscillations increase here.

12182 (INIS-SU—369, pp 285-288) **Investigation of the dependence of the ErFI electron storage ring main parameters on the periodicity cell structure.** Karabekov, I.P.; Tsakanov, V.M. (Erevanskij Fizicheskij Inst., USSR). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Main criteria of optimization of storage ring periodicity cell structure are given. Study of the creterion dependence on the cell structure and strong focusing is carried out by an example of the designed synchrotron radiation (SR) source of Erevan Physical Institute ERSINEh-1.5. It is shown that the most preferable periodicity cell structure, permitting to reach high values of SR source luminosity and comparatively low HF generator power, is the structure OFOBODO. But absence of free gaps excludes the possibility of positioning special radiation sources - wigglers and ondulators.

12183 (INIS-SU—369, pp 314-317) **On-line system for continuous radiation control of the VEPP-4 electron-positron accelerating-storage facility (structure and implementation).** Kargal'tsev, V.V.; Koryabkin, O.M.; Repkov, A.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

An on-line system for estimation of radiation conditions at the VEPP-4 to ensure radiation safety is described. The measuring part of the system comprises detection units placed in the region of the complex, equipment, recording signals of detection units, timer, clock of absolute time and microcomputer. The system units are performed in the CAMAC standard. A programmed crate-controller is used as a microcomputer. The system represents data for the operator, gives warning to radiation conditions, changes operation mode of the complex units to prevent personnel exposure, and it exercises acquisition, storage, processing and documentation of obtained data for following analysis of radiation condition.

12184 (INIS-SU—369, pp 318-324) **On-line system for continuous radiation control on the VEPP-4 electron-positron accelerating-storage facility. Aims, approach, detectors.** Barkova, V.G.; Koryabkin, O.M.; Repkov, A.V.; Chudaev, V.Ya. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Necessity to create on-line system for radiation monitoring (ORMS) on the VEPP-4 is grounded. ORMS radiation detectors are described. It is shown that under the VEPP-4 operating conditions there exists some factors considerably decreasing the accuracy of radiation protection estimations based on indications of ORMS detectors and other means of operative radiation monitoring. The action of pure equimonitoring type factors includes the formation of rather different and unstable time distributions of the equivalent dose through the body. Detector unfitness, which are designed for maximum equivalent dose (MED) measurement under conditions of standard frontal-body radiation, for evaluation of effective equivalent dose at unstable in time energy angular radiation distribution can lead to considerable uncertainly about interpretation ofoperative control results. Inspite that further decreasing of errors becomes rather desirable, the detectors implemented can provide, in most cases, the accuracy acceptable for operative forecasting purposes (at least for protection). The most radical solution is the creation of a dosimeter-phontone filled with equivalent dose detectors suitable for operation in pulsed fields.

12185 (INIS-SU—369, pp 335-342) **Simulation of the UNK superconducting dipole magnets.** Ageev, A.I.; Andreev, N.I.; Balbekov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Test results of the UNK short superconducting 750 mm long dipoles and full-scale superconducting 6 m long dipoles are presented. Dependences of dynamic losses on the value of the field in the centre of aperture as well as total and hysteresis losses are presented for short dipoles. Dependence of critical dipolecurrent on supplimentary heat releases in the coil as well as on the rate of current input is given. Operating field of 5T is obtained both in short and in full-scale models.

12186 (INIS-SU—369, pp 350-359) **Comparison of methods for cryostating superconducting dipole magnets.** Son Zun Gan; Filippov, Yu.P.; Zinchenko, S.I. (Joint Inst. for Nuclear Research, Dubna, USSR; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

An attempt is made to refine basic parameters of the UNK cryogenic system with account of real characteristics of horizontal two-phase helium flows and to project ways of optimizing these parameters. The method 1 where liquid helium in the state close to saturation is supplied to the chain of magnets and removes heat releasing in coils and coming from environment at the expense of phase transformation and it leaves the chain as vapour-liquid mixture, is compared with the method 2 where magnet cooling is arranged at the expense of heat transfer from one-phase direct flow to two-phase helium counter flow. The results of calculations are presented as dependences of maximum temperatures of coils on the length of magnetic path. It is shown that at the length of chain of about 300-400 m both methods are practically equivalent by temperature criterion, but the method 1 is preferable due to simpler design of the cryostat and lesser helium quantity in the system.

12187 (INIS-SU—369, pp 360-367) **Space charge effects in the UNK.** Balbekov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

The paper deals with the next problems of spce charge effects in the UNK: Coulomb shifts of betatron frequencies at high energies, their effect on betatron oscillation stability and possibility of their compensation; transverse wall instability of a beam and ways necessary for its suppression; longitudinal instability of a bunched beam and tolerances for vacuum chamber elements impedance.

12188 (INIS-SU—369, pp 371-375) **Requirements to field nonlinearity in the UNK superconducting magnets.** Balbekov, V.I.; Drozhdin, A.I.; Myznikov, K.P.; Fedotov, Yu.S.; Chirkov, P.N.; Yazynin, I.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Effect of systematic perturbations of the magnetic field on distortion of beam phase volume and increase of its dimensions in the UNK as well as systematic nonlinearities of dipoles exciting structural resonances is investigated. Inaccessibility of betatron frequencies approuching under injection and acceleration to resonances of 3 and 4 orders for the distance less than approximately

0.04 and approximately 0.01 respectively is shown. Permissible frequency spread in a beam equals approximately 0.03.

12189 (INIS-SU—369, pp 376-379) **Study on dynamic losses in the superconducting cable of the UNK magnets.** Dmitrevskij, Yu.P.; Zlobin, A.V.; Nikulin, A.I.; Shumskij, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A plane transposed superconducting (SC) cable of the Resenford type, consisting of 23 cable conductors 85 mm in diameter, containing 2970 twisted niobium-titanium filaments 10 μm in diameter of copper matrix is chosen as a current-carrying element of the UNK SC magnets. Cable specimens with different designed and technological solutions (cable conductor coating, a twist step of SC filaments, relative direction of twisting and transposition) are investigated. It is shown that during the cycle with the amplitude of 2.64 T and the rate of magnetic field induction rise of 0.1-0.2 T/s the additional vertex losses in the cable with tinned twisted cable conductors with 8-9 mm step constitute 100-200 MJ/cm³, that essentially exceeds hysteresis losses, being equal to 30-35 MJ/cm³ in the given cycle. In cable with alternating tinned and oxidized cable conductors, the additional vertex losses are much lower. Evaluations of dynamic losses in the UNK dipole in the trapeziform cycle of 800 A-6000 A-800 A with the rate of current change 130 A/s during 40 min and the flat-top at 6000 A with 40 s duration are carried out on the base of experimental data obtained. According to these evaluations, accounting magnetic field distribution in winding, the level of heat release per a meter of a magnet length in the current-carrying element is approximately 130 J/m x cycle. In this case hysteresis losses give about 100 J/m x cycle. Mean loadfor cryogenic system doesn't exceed 1.1 W/m.

12190 (INIS-SU—369, pp 380-383) **Study on a cryogenic module model.** Ageev, A.I.; Zinchenko, S.I.; Levin, M.V.; Logachev, S.N.; Shamichev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov., Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

A test bed to investigate full-scale superconducting magnets (SCM) of the UNK in pumping-through refrigeration mode is developed. It makes possible to provide coolant circulation through SCM channels at relatively low refrigerator power of 400W by a quantity of 100g/s at input temperature of the magnet 40 K. The cryogenic system of the pumping-through test bed is similar both by flowchart solution and by equipment composition to the UNK cryogenic module, that permits to carry out investigation of basic module elements aimed at producing recommendations for equipment designing of the UNK cryogenic module. Satellite refrigerator investigations show considerable desagreement between calculation and the experiment, that is explained by effects of secondary factors on heat exchanger operation. It is shown that satellite heat exchangers possess high-temperature efficiency, and thus it is necessary to account the effect of axial heat conductivity during heat exchanger designing.

12191 (INIS-SU—369, pp 395-398) **Development of the UNK kicker magnet prototype section.** Andreev, V.N.; Emel'yanov, A.B.; Kurnaev, O.V.; Matsenko, S.I.; Sychev, V.A.; Trofimov, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of the development of the UNK kicker magnet (KM) prototype section are presented. It is supposed to arrange all the magnets of three-meter length sections. A KM two-modular section of the beam input into the first stage is developed as a prototype sample. The field pulse rise front in the KM gap constitutes about 0.5 μs, the decayless than 5 μs. The integral field inhomogeneity no worse than +-0.3% in a 50 x 50 mm² working apperture is achieved. For magnets with 5 μs field pulse rise front a pulse generator, based on a linear moulator with IPT-6-type ignitron spark gap, which has successfully undergone continued testing is developed. On additional module in the hot reservation regime is supposed to be used in all the kicker magnets.

12192 (INIS-SU—369, pp 407-412) **Status of the HERA-project.** Wrulich, A. (Deutsches Elektronen-Synchrotron, DESY, Hamburg, Germany, F.R.). 1985. NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Status of the ep project HERA with the designed luminosity of 3.1x10^{31} cmsup(-2) secsup(-1) is described. General layout and layout of the interaction region is shown. The progress of the electron ring and proton ring is described. Layout of the refrigeration system is shown. At the beginning of 1985 the boring machine will start with the tunneling, which is expected to be completed at the end of 1987. The electron ring is expected to be finished early is 1988, the proton ring one year later. Experimentation could start in 1990.

12193 (INIS-SU—369, pp 233-237) **VEPP-4: status and prospects.** Anashin, V.V.; Brovin, M.M.; Voblyj, P.D. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Results of the VEPP-4 modification are presented, experiments conducted lately are enumerated, plans for further modification are described. Two "snakes" - 120 cm magnet with a flat sign-alternating field were installed in the VEPP-4, which permitted to suppress coherent instability. Power supply sources were modernized. Works to increase the luminoosity are conducted. In 1983-1984 the following experiment were carried out: precise mass measurements for γ' and γ''-mesons; measurement of lepton width of γ-meson; biphoton physics experiments. Spin dependence of synchrotron radiation intensity has been observed for the first time. On the basis of a laser polarimeter a source of the 800 MeV monochromatic γ-quanta is developed. Measures to increase the VEPP-4 luminousity by an order are enumerated. Modernization of the central part of the MD-1 detector is planned, as well as production of longitudinally polarized beams and interaction energy monochromatization.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 10909, 11264, 12513, 12514, 12621, 12747, 12853, 12854, 12857, 12863

12194 **(AD-A—172568/8/XAB) Calorimetric dose measurements and calorimetric system developed for the Armed Forces Radiobiology Research Institute. Contract report.** McDonald, J.C. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Aug 1986. 29p. (AFRRI-CR—86-1). NTIS, PC A03/MF A01.

This report describes measurements that were carried out with a tissue-equivalent (TE) plastic calorimeter. This calorimeter was used in the radiation fields produced at the Armed Forces Radiobiology Institute (AFRRI) LINAC (linear acccelerator), reactor, and cobalt-60 sources. The calorimeter was used as a cross-check for other dosimetry in use of AFRRI because its response is essentially independent of dose rate and ionization density. This is important to dose measurements at AFRRI because the radiation sources there are high in intensity, capable of delivering single pulses, and, in the case of the reactor, high in LET (linear energy transfer). The other types of dosimeter systems at AFRRI include TE and nonhydrogenous ionization chambers and activation foils. Ionization

chambers suffer from recombination problems when exposed to high dose rates and high-LET radiations, and activation foils require knowledge of the neutron energy spectrum. The calorimeter is not subject to these restrictions, which makes it useful for intercomparison studies.

12195 **(AD-A—172717/1/XAB) Evaluation of a high-pressure proportional counter for the detection of radioactive noble gases. Final report.** Hedtke, R.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). 10 Mar 1986. 110p. (AFIT/GNE/PH—86M-7). NTIS, PC A06/MF A01.

The performance of a modified high-pressure proportional counter to detect and resolve /sup 133m/Xe and ^{133}Xe in a gaseous mixture is evaluated. Modifications to the previous system included installation of field tubes in the detector and use of titanium and zirconium turnings in the purification system. Three external sources were used to determine operational characteristics of the detector: ^{241}Am, ^{109}Cd, and ^{57}Co. The fill gases used were pure argon and pure xenon at pressures of 5, 10, 20 and 50 atmospheres. Optimum resolutions were measured, as a function of anode voltage, for each fill gas at the various pressures tested. Resolutions, with argon fill gas, varied from 3.56 keV for the 60-keV peak of ^{241}Am to 30.2 keV for the 88 keV peak of ^{109}Cd. Resolutions with xenon as the fill gas ranged from 4.4 keV for the 60-keV peak of ^{241}Am to 22.3 keV for the 122-keV peak of ^{57}Co. Efficiencies in argon were approximately 1% and they varied for xenon from 1 to 45%. An internal source consisting of ^{133}Xe, /sup 133m/Xe, and stable xenon was used in the final phase of the study. The system modifications functioned well; however, the ultimate goal of resolving the xenon radionuclides was not conclusively achieved. Some experimental results indicated the presence of the /sup 133m/Xe in the ^{133}Xe gas; however, more research is necessary to confirm this capability.

12196 **(AD-A—172877/3/XAB) Technical evaluation of Dosimeter Corporation of America Model 005 Pocket Dosimeter USAFOEHL, Brooks AFB, Texas. Final report.** Caldwell, J.A. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Aug 1986. 12p. (USAFOEHL—86-069RE0094HXA). NTIS, PC A02/MF A01.

A technical evaluation of the DCA Model 005 Pocket Dosimeter was accomplished on 18-19 Jun and 1 Jul 86 at Kelly and Brooks AFB to access the variability caused by temperature and humidity extremes. Discrepancies were identified and considerations recommended.

12197 **(BNL—38861) Gain reduction due to space charge at high counting rates in multiwire proportional chambers.** Smith, G.C.; Mathieson, E. (Brookhaven National Lab., Upton, NY (USA); Leicester Univ. (UK). Dept. of Physics). Oct 1986. Contract AC02-76CH00016. 5p. (CONF-861007—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003207.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

Measurements with a small MWPC of gas gain reduction, due to ion space charge at high counting rates, have been compared with theoretical predictions. The quantity $\ln(q/q_0)/(q/q_0)$, where (q/q_0) is the relative reduced avalanche charge, has been found to be closely proportional to count rate, as predicted. The constant of proportionality is in good agreement with calculations made with a modified version of the original, simplified theory.

12198 **(BNL—38889) Diffractive production of W, Z, top, + ??? at the SSC.** Foley, K.J.; Schlein, P.E. (Brookhaven National Lab., Upton, NY (USA); California Univ., Los Angeles (USA)). 1986. Contract AC02-76CH00016. 3p. (CONF-8606215—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003235.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

A detector for the Superconducting Super Collider is outlined and its key parameters are fixed to facilitate the study of very heavy flavors and heavy vector bosons as well as the Pomeron. (LEW)

12199 **(BNL—38914) Small angle spectrometers: Summary.** Courant, E.; Foley, K.J.; Schlein, P.E.; Rosner, J.; Slaughter, J.; Bromberg, C.; Jones, L.; Garren, A.; Groom, D.; Johnson, D.E. (Brookhaven National Lab., Upton, NY (USA); California Univ., Los Angeles (USA); Chicago Univ., IL (USA); Yale Univ., New Haven, CT (USA); Michigan State Univ., East Lansing (USA); Michigan Univ., Ann Arbor (USA)). 1986. Contract AC02-76ER03075;AC02-82ER40073;AC02-76CH00016. 4p. (CONF-8606215—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003205.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

Aspects of experiments at small angles at the Superconducting Super Collider are considered. Topics summarized include a small angle spectrometer, a high contingency spectrometer, dipole and toroid spectrometers, and magnet choices. (LEW)

12200 **(BNL—38946) Current technology of particle physics detectors.** Ludlam, T.W. (Brookhaven National Lab., Upton, NY (USA)). 23 Jun 1986. Contract AC02-76CH00016. 32p. (CONF-8606241—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE87003232.

From 3. Continuous Electron Beam Accelerator Facility summer school; Newport News, VA, USA (23 Jun 1986).

A brief discussion is given of the characteristics required of new accelerator facilities, leading into a discussion of the required detectors, including position sensitive detectors, particle identification, and calorimeters. (LEW)

12201 **(DOE/DP/40199—3) X-ray reflection from novel multilayers with variable smoothness and figure: Final technical report for the period 1 April 1984-15 May 1986.** Knight, L.V.; Thorne, J.M. (Brigham Young Univ., Provo, UT (USA)). Sep 1986. Contract AS08-84DP40199. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003907.

The theory of Bragg diffraction of soft x rays from thin-film multilayers has been refined and extended to include the effects of interfacial roughness and diffusion. This theory, together with a recently improved data base, has allowed the development of reliable design procedures for various multilayer applications. Different designs can emphasize peak reflectivity, high resolution, heat resistance, or other characteristics. Success has been achieved in the fabrication of heat-resistant multilayers and in producing controllably curved silicon substrates for multilayers.

12202 (DOE/ER/03496—80, pp 163-196) **On- and off-line tests of a neutron multiplicity meter.** Datta, S.S.; Toeke, J.; Schroeder, W.U.; Wile, J.L.; Kosky, J.P.; de Souza, R.T. (Univ. of Rochester, NY). Aug 1986. NTIS, PC A13/MF A01. File Number DE85017572. (COO—3496-80).

In Studies of heavy ion reactions and transuranic nuclei. Progress report, September 1, 1984-August 31, 1985.

In order to develop an experimental technique for the determination of multiplicity distributions of neutrons emitted in heavy-ion-induced reactions, a 4π-liquid scintillator neutron detector (NMM) has been installed at the University of Rochester tandem accelerator. The performance of the NMM and of its associated electronics was tested employing a ^{252}Cf fission neutron standard. Successful in-beam tests of the NMM were carried out with fusion-evaporation reactions induced by 104-145 MeV ^{28}Si projectiles on / sup nat/Sn and ^{124}Sn targets.

12203 (DOE/ER/03496—80, pp 266-287) **Development of a large area ionization chamber.** de Souza, R.T.; Birkelund, J.R.; Schroeder, W.U.; Butler, M.A.; Datta, S.S.; Huizenga, J.R.; Wile, J.L. (Univ. of Rochester, NY). Aug 1986. NTIS, PC A13/MF A01. File Number DE85017572. (COO—3496-80).

In Studies of heavy ion reactions and transuranic nuclei. Progress report, September 1, 1984-August 31, 1985.

A large area ionization chamber is currently being developed. The energy resolution in both stop and transmission modes has been determined to be on the same order as that of a silicon

solid-state detector. A plastic scintillator light guide assembly has also been built, and testing of this stop detector is in progress.

12204 **(LA-UR—86-3493) Portable x-ray spectrometer/ dosemeter based on a silicon diode.** Eisen, Y.; Olsher, R.H.; Brake, R.J.; Littlejohn, G.J.; Meddles, A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 21p. (CONF-870219—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001961.

From Midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

We developed a portable x-ray spectrometer/dosemeter based on a silicon p-i-n diode. The instrument is capable of obtaining spectral information in the region from 18 keV to 150 keV and measuring photon exposures in the region from 18 keV to 1.3 MeV. A theoretical method is described for obtaining a nearly air equivalent response in the energy region above 18 keV. The instrument has a dynamic range for most energies between 0.5 mR/h and 5 R/h. Its small size, ability to provide spectroscopic output, and satisfactory air equivalent response over a wide energy range, make this instrument more attractive than portable ionization chambers.

12205 **(N—87-11589) Effects of backing plates on the electron exposure of thin polymer films.** Chang, C.K.; Seltzer, S.M.; Wilson, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Nov 1986. 16p. (NASA-TM—88995; L—16183; NAS—1.15:88995). NTIS, PC A02/MF A01.

The effects of backing plates on the radiation dose received by thin nylon films were calculated using recently developed multilayer electron transport codes. The film dose increased with increasing atomic number of the backing plate. The estimated dose could be off by a factor of 2 or more if the backing plate were ignored in the calculations.

12206 **(OEFZS—4371) Results of an intercomparison of gamma spectrometers in Austria; volume source ^{134}Cs and ^{137}Cs A-1986.** Steger, F.; Henrich, E. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Strahlenschutz). Sep 1986. 22p. (In German). (ST—140/86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700444.

After the Chernobyl-disaster a comparison for gamma spectrometric evaluations in Austria with the radionuclides Cesium 134 and Cesium 137 was organized. Results are presented and data such as comparison, reproducibility and others were calculated.

12207 **Microwave detector.** Meldner, H.W.; Cusson, R.Y.; Johnson, R.M. (to Dept. of Energy, Washington, DC). US Patent 4,626,791. 2 Dec 1986. Filed date 8 Feb 1985. v.p.

A detector is described for measuring the envelope shape of a microwave pulse comprised of high-frequency oscillations, the detector comprising: a B-dot loop linking the magnetic field of the microwave pulse; a biased ferrite, that produces a magnetization field flux that links the B-dot loop. The ferrite is positioned within the B-dot loop so that the magnetic field of the microwave pulse interacts with the ferrite and thereby participates in the formation of the magnetization field flux; and high-frequency insensitive means for measuring electric voltage or current induced in the B-dot loop.

12208 **Performance of CRISIS and its calibration.** Goloskie, D.; Kistiakowsky, V.; Oh, S.; Pless, I.A.; Stoughton, T.; Suchorebrow, V.; Wadsworth, B.; Murphy, O.; Steiner, R.; Taft, H.D. (Massachusetts Institute of Technology, Cambridge). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **A238**: 61-73(1985).

The authors describe the calibration of CRISIS, a charge sensitive drift chamber which makes possible the identification of charged particles with momentum between 5 and 100 GeV/c. Results indicate an optimum resolution of (7.1 +/- 0.2)% fwhm, which is an improvement over the predicted value of 7.8%. They characterize the efficiency for particle identification by the ratio b = (separation between π and p)/(σ/sub π/ + σ/sub p/). They achieve a value of (0.94 +/- 0. 02), which compares favorably with the theoretical value of 0.87 at 200 GeV. In addition to particle identification, the data from this detector will augment the other components of the Fermilab hybrid spectrometer to reconstruct particle trajectories in real space.

12209 **Scintillation counting: an extrapolation into the future.** Ross, H.H. (Oak Ridge National Lab., TN, USA). pp 1-15 of Advances in scintillation counting. McQuarrie, S.A.; Ediss, C.; Wiebe, L.I. (eds.) (Alberta Univ., Edmonton (Canada). Faculty of Pharmacy and Pharmaceutical Sciences). Edmonton, Alberta; University of Alberta (1983). (CONF-830565—). Contract W-7405-ENG-26.

From Advances in scintillator counting conference; Banff, Alberta, Canada (15 May 1983).

Progress in scintillation counting is intimately related to advances in a variety of other disciplines such as photochemistry, photophysics, and instrumentation. And while there is steady progress in our understanding of luminescent phenomena, we are in the middle of a virtual explosion in the application of semi-conductor technology to detectors, counting systems, and data processing. The exponential growth of this technology has had, and will continue to have, a profound effect on the art of scintillation spectroscopy. This paper will review key events in technology that have had an impact on the development of scintillation science (solid and liquid) and will attempt to extrapolate future directions based on existing and projected capability in associated fields. Along the way, there have been occasional pitfalls and several false starts; these too will be discussed as a reminder that if you want the future to be different that the past, study the past.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 11600

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 10707, 10767, 10768, 10823, 10877, 11625, 11735, 11799, 11954, 12005, 12006, 12228, 12416

12210 **(EGG—10282-5022) Amplitude-independent fiber-optic pressure sensor: Final report, FY86.** Macy, D.; Malone, R.M. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations). Dec 1986. Contract AC08-83NV10282. 45p. D; 2; GPO Dep. File Number DE87003873.

A Fiber-Optic Pressure Sensor (FOPS) is described, which is a light-amplitude independent instrument for detecting displacement of a pressure-activated diaphragm. The FOPS is used to measure static pressure via a single multimode fiber link in areas with high electrical interference. The sensor and its theory of operation are described, as well as its calibration, multiplexing, and fielding. (LEW)

12211 **(EPRI-CS—4846) Field evaluation of the S-Cubed model PCBA-102 PCB [polychlorinated biphenyl] analyzer: Final report.** Hein, J.C.; Mew, D.; Parker, D.S. (Brown and Caldwell, Emeryville, CA (USA). Analytical Services Div.). Oct 1986. 64p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920103.

Results of field tests for a portable polychlorinated biphenyl (PCB) analyzer are reported. In an evaluation program, the prototype unit, PCBA-102, was outfitted in a half-ton van and loaned to five utilities. They used it in both soil and transformer oil analysis. Each utility returned comments concerning operation and outside lab comparison data. Laboratory data from the PCBA-102 were compared to data from the Environmental Protection Agency method 8080 using regression statistics. A field study was also done consisting of on-site soil analysis at a number of transformer substations. (LEW)

12212 **Stigmatic high throughput monochromator for soft x rays.** Hettrick, M.C.; Underwood, J.H. (Lawrence Berkeley Laboratory, Center for X-Ray Optics, Berkeley, California 94720). *Applied Optics;* **25**: No. 23, 4228-4231(1 Dec 1986). Contract AC03-76SF00098.

A stigmatic high-throughput monochromator for soft x radiation is designed using spherical gratings, and high spectral resolution is achieved.

12213 **Results of single and two-dimensional audit experience with customers, an alternate MAP approach.** Braudaway, D.W. (Sandia National Labs., Div. 7241, Albuquerque, NM 87185). pp 183-189 of Proceedings of the 1986 IEEE instrumentation on measurement technology conference. Piscataway, NJ; IEEE Service Center (1986). (CONF-860354—). Contract AC04-76DP00789.

From IEEE conference on instrumentation and measurements; Boulder, CO, USA (25 Mar 1986).

Measurement Assurance Programs (MAPs) available from NBS are well-known methods of transferring physical and electrical values. However, where accuracy requirements are moderate it is not often practical to make use of these elegant techniques. In the broad definition sense MAP includes any technique by which the quality of measurements may be assured. Audit of measurement capability can fill the need for many lower accuracy requirements. Described are philosophies and types of audits. Also described are the results of 8 years of technical audit of 11 laboratories using single and two-dimensional length artifacts. Modification to length audit philosophy to meet requirements of new computer-operated measuring equipment are briefly presented.

12214 **Minimization of operator-balance interactive warmup by use of an "alter ego" heat source.** Braudaway, D.W. (Sandia National Labs., Div. 7241, Albuquerque, NM 87185). pp 115-120 of Proceedings of the 1986 IEEE instrumentation on measurement technology conference. Piscataway, NJ; IEEE Service Center (1986). (CONF-860354—). Contract AC04-76DP00789.

From IEEE conference on instrumentation and measurements; Boulder, CO, USA (25 Mar 1986).

Abstract-Operator-equipment interaction is a wellknown but frustrating part of many high precision measurements. Deterioration in performance of a high-precision balance compelled testing to identify the cause of the problem and to establish effectiveness of the solution. An unexpected result of the tests was a clear characterization of a significant operator-balance thermal interaction and verification of the empirically determined warmup requirement. The repeatability of the interactive effect inspired development of a replacement for the operator using an "alter ego" heat source.

12215 **Circular differential microscopy.** Maestre, M.F.; Bustamante, C.; Keller, D. (Lawrence Berkeley Lab., Berkeley, CA). pp 133-146 of Applications of circularly polarized radiation using synchrotron and ordinary sources. Allen, F.; Bustamante, C. New York, NY; Plenum Press (1985). (CONF-8405239—).

From Workshop on applicatons of circularly polarized synchrotron radiation; Albuquerque, NM, USA (18 May 1984).

The authors describe the historical development of the theory of differential imaging and the invention of the circular differential imaging microscope. The technique is shown to be a logical extension of the research on the interaction of circularly polarized light with stuctures whose dimensions are arbitrary with respect to the wavelength of light. Shown is the circular dichroism spectra in arbitrary units of E. cirrhosa sperm heads, measured by techniques with different collection angles of scattered light. Also presented is a scanning electron micrograph of a freexe-dried sperm head from E. cirrhosa. It was shown that circular differential scattering is specially sensitive to the dimensions of the structure close to the wavelength of the incident light, and application of circular intensity differential scattering theory to images extend these results.

12216 **Effect of detector geometry on AEM-based x-ray microanalysis. II. Experimental.** Maher, D.M.; Ellington, M.B.; Joy, D.C.; Schmidt, P.H.; Zaluzec, N.J.; Mochel, P.E. (Bell Labs., Murray Hill, NJ). pp 29-32 of Analytical electron microscopy - 1981. Geiss, R.H. (ed.). San Francisco, CA; San Francisco Press, Inc. (1981).

In this paper the experimental variation of I/sup ka//I/sup K(a+b)//sub Si/ with specimen tilt is reported for the three detector geometries and three types of microscopes. All measurements were made at an accelerating voltage of 100 keV. Experimental results for three detector/specimen geometries are compared. For the low- and intermediate-angle configurations, the measured intensity ratios increase as omega/sub X/ is reduced; whereas in the case of the high-angle configuration, the intensity ratio decreases. 5 references, 4 figures, 1 table.

45 EXPLOSIONS AND EXPLOSIVES

12217 **(AD-A—172799/9/XAB) Thermal effects on a rotating missile. Master's thesis.** Kristensen, D.H. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 96p. (AFIT/GNE/ENP—86M-9). NTIS, PC A05/MF A01.

This thesis sought to determine if rotation would decrease the maximum skin temperature of an ICBM, thus increasing its probability of survival. The first scenario investigated was the Peacekeeper Dense Pack system. The missile field was subjected to a walk attack of 2 MAT weapons, with incoming RV's exploding every two secs. The 2nd scenario was a 4-on-1 attack of a missile-launching system--specifically, one missile was subjected to four bursts located in various positions surrounding the missile. Finally, a missile is attacked by a space-based laser with a maximum absolute power of 10 megawatts. In all cases, the rotation rate was limited to a maximum of 1.6 radians/sec. In all scenarios studied, rotation significantly decreased the maximum skin temperature and increased the missile's probability of survival. The decrease was most dramatic for the walk attack where an optimum rotation rate of .8 radians/sec was established. For the 4-on-1 attack, rotation was effective but required the maximum 1.6 radians/sec rotation rate for best results. For the laser threat rotation was effective, with the maximum rotation rate providing the greatest amount of protection.

4501 Chemical

REFER ALSO TO CITATION(S) 11594, 11595

12218 **Modeling particle size and initial temperature effects on shock initiation of TATB-based explosives.** Cochran, S.G.; Tarver, C.M. (Lawrence Livermore National Lab., CA). pp 593-596 of Shock waves in condensed matter - 1983. Asay, J.R.; Graham, R.A.; Straub, G.K. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (1984). Contract W-7405-ENG-48.

The statistical model of shock initiation of heterogeneous solid explosives treats explicitly the shock induced locally heated regions (hot spots) that can thermally diffuse out or chemically react to become local reaction sites which then grow in a linearly pressure dependent process to consume the remaining unreacted explosive. Calculations with this model are presented which accurately simulate the available experimental data on the effects of particle size distribution, initial temperature, and initial density on the shock sensitivity of triaminotrinitrobenzene (TATB)-based explosives. 12 references, 4 figures.

12219 **Measured Hugoniot states of a two-element fluid, $O_2 + N_2$, near 2 Mg/m³.** Schott, G.L. (Los Alamos National Lab. NM). pp 49-52 of Shock waves in condensed matter - 1983. Asay, J.R.; Graham, R.A.; Straub, G.K. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (1984).

Measured single-shock Hugoniot quantities are reported for a 1:1 atomic mixture of the elements oxygen and nitrogen in each of two liquid initial states. One of these is the inert equimolar solution $O_2 + N_2$, at T ~ 85K, v ~ 1.06 m³/Mg; the other is the pure

explosive compound nitric oxide, NO, at T ~ 122K, v ~ 0.79 m^3/Mg. First-shock pressures are in the range 10-30 GPa. The two Hugoniots have common values of specific volumes and energies near 20 GPa; that is, they intersect. This permits a novel test of attainment of steady waves with equilibrium composition, such that a single equation of state may describe the shocked reactive fluid. 19 references, 5 figures.

4502 Nuclear

REFER ALSO TO CITATION(S) 11194, 12261, 12966, 12973

12220 (AD-A—172453/3/XAB) Survivability of the hardened mobile launcher when attacked by a hypothetical rapidly retargetable ICBM system. Master's thesis. Gearhart, D.J.; Merrow, S.F. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 128p. (AFIT/GST/ENS—86M-9). NTIS, PC A07/MF A01.

This thesis evaluates the survivability of the hardened mobile launcher system (HML) against a hypothetical enemy ICBM system. The hypothetical system has two key capabilities: it can obtain near real-time intelligence information regarding the HML's location, and it can be retargeted in flight (as necessary) according to the intelligence information. Thus, the hypothetical ICBM threat systems can attack individual HMLs directly rather than rely on a barrage attack against HML bases. Monte Carlo simulation is used to approach the problem. The model is an MBASIC computer program, written and runs on an Apple Macintosh computer. The model simulates the flight of the attacking ICBMs (there may be as few as one or as many as 14 warheads directed at each HML) and the random dispersal tactics of a single HML. The model determines the locations of the detonations and the location of the HML at time of detonation. Based on these locations, probability of kill due to peak-blast overpressure is calculated. A key parameter in the model is intelligence / retargeting cycle time -- the time required to obtain intelligence and retarget accordingly. This time is varied from 1-30 minutes. The model also allows variations in HML speed and hardness and threat system CEP. A subroutine for examining the effects of neutron fratricide on the attacking warheads is included (although the effects were found to be negligible). The thesis concludes that very small intelligence/retargeting cycle times are required for this to be an effective weapon system against the HML. Thus, with today's (or near future) technology, the HML can be considered a very survivable system.

12221 (AD-A—172489/7/XAB) Recovery of MILL RACE ground-motion canisters and examination of canister emplacement. Technical report, 1 October 1982-31 May 1983. Vincent, C.T.; Cheeseborough, J.C. (Physics Applications, Inc., Los Angeles, CA (USA)). 31 May 1983. 54p. (PATR—213-1). NTIS, PC A04/MF A01.

The canisters used for the strain-path project of the MILL RACE program were excavated, along with their emplacement grout, to find out why the grout had often risen to higher levels than those expected from borehole and canister geometry, and because some large variations in ground motion measurements from adjacent canisters could have been due to faulty canister installation. In most cases it was found that the canisters were embedded only partly in grout, and, in 11 of the 24 holes, half or more of the canister's surface proved to be grout-free; dirt had fallen from the sidewalls to the bottoms of boreholes before or during grouting. However, no significant correlation was found at Applied Theory, Inc. between the degree of grouting and anomalies in ground-motion records.

12222 (AD-A—172769/2/XAB) Determination of lateral spread of nuclear-fallout patterns. Master's thesis. Schneider, D.P. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 97p. (AFIT/GNE/PH—86M-12). NTIS, PC A05/MF A01.

This report develops an improved method of determining the lateral spread of nuclear fallout. A full physics model of pattern development based on particle mass is analyzed. A rapid, simplified method for the prediction of nuclear-fallout patterns is developed for the case of a 1-Mt weapon based on empirical data from WSEG-10. This model is extended to other weapon sizes.

12223 (AD-A—172780/9/XAB) Cumulative thermal effects in a multiburst scenario. Master's thesis. Hall, B.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1985. 159p. (AFIT/GNE/ENP—85M-8). NTIS, PC A08/MF A01.

This thesis sought to develop a computer program to model the cumulative effects of nuclear fireball thermal radiation. The scenario studied was the Peacekeeper Dense Pack missile system. The missile field was subjected to walk attack of 2-MT weapons every two seconds. Aiming error of the incoming RV was modeled using a 10-cell CEP area around the designated ground zero, and the probability of damage due to an RV was calculated using a cumulative log-normal distribution function. To model the missile skin-temperature rise, an energy balance was made over a unit area of skin surface and then solved using the thin-skin approximation and finite differences. The maximum temperature reached was used to calculate the probability of damage to the missile skin. The amount of thermal radiation emitted from each burst independently. Cumulative thermal effects thus proved to have a greater region of no survival than noncumulative thermal effects and also blast effects.

12224 (AD-A—172784/1/XAB) Effect of dust models on global nuclear winter. Master's thesis. Pontier, P.Q. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 49p. (AFIT/GNE/ENP—86M-11). NTIS, PC A03/MF A01.

A series of optical-depth calculations were accomplished to assess the effects of various existing dust and soot models on the transmission of incident sunlight. A change in the standard deviation of the particle-size distribution from two to four, assuming constant total density, resulted in a decrease in the visible optical depth by a factor of ten. A technique using a method of direct integration was developed for the calculation of the effective optical depth of nuclear-induced dust and soot clouds. Contributions from directly transmitted photons, first scattered photons using anisotropic cross sections, and all subsequently scattered photons were used to calculate the amount of light transmitted through the cloud. Absorption effects were also included. The results of this study were comparable to the results of several recent nuclear winter studies.

12225 (AD-A—172960/7/XAB) Numerical method for unfolding the stabilized nuclear-cloud particle distribution. Master's thesis. Felty, J.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 130p. (AFIT/GNE/PH—86M-4). NTIS, PC A07/MF A01.

A numerical unfolding of particle-size distribution from reduced airborne filter sample data is developed. First, stabilized nuclear cloud is modeled using a trial particle-size distribution that is positioned in the atmosphere by empirical relationships. Then Davies-McDonald fall mechanics are used to model the falling particles in the cloud. The amount of mass at each sample altitude at each sample time is calculated from the cloud model and compared to the amount of mass found in actual cloud samples. When the calculated masses equal the actual masses, the particle distribution used to construct the stabilized cloud is the correct one. A computer code for this numerical analysis is tested using hypothetical filter sample data constructed from a known particle-size distribution. An input parameter sensitivity analysis is also conducted. Actual nuclear cloud sample data from the Redwing series ZUNI shot is analyzed using this numerical method of airborne nuclear cloud sample analysis. The outcome of the ZUNI sample analysis is somewhat inconclusive in that it does not pinpoint a distribution. However, results of the model sensitivity analysis indicate that the particle size distribution of the stabilized ZUNI cloud may be lognormal with a log-slope between 2.9 and 3.9.

12226 (AD-A—173520/8/XAB) NCS EMP (National Communications System Electromagnetic Pulse) mitigation program: Aerial TI System test plan. Final report. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Aug 1986. 32p. NTIS, PC A03/MF A01.

This program mitigates the damaging effects of nuclear weapons on regional and national telecommunications capabilities.

To meet this objective, the OMNCS has sponsored efforts to create a network level model to assess the effects of High-Altitude EMP (HEMP). In addition, the OMNCS has sponsored efforts to collect the level HEMP effects to data required to support the network-level model. The products of this model will assist the NCS in identifying potential vulnerabilities of national telecommunications capabilities to HEMP and to support National Security & Emergency Preparedness (NSEP) initiatives.

12227 **(LA—10873-M) Symbolic histogram user's guide.** Mills, C.F. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 17p. NTIS, PC A02. File Number DE87003798.

HISTPLT is an interactive program that writes a MAPPER file to produce symbolic histograms. Symbolic histograms are often used by containment scientists to present comparisons of the physical properties of related holes at the Nevada Test Site to the Containment Evaluation Panel at the Nevada Operations Office. Symbolic histograms may be used for noncontainment presentations also, so HISTPLT has been designed to plot other data as well. 3 figs.

12228 **(SAND—86-0395) The development of diagnostic fuses.** Conley, W.R. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1986. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003280.

This report summarizes a development effort that resulted in the fabrication of passive diagnostic devices for underground testing. These devices are currently being used to measure the energy content of electrical pulses induced in cables by x-ray radiation.

12229 **(UCRL—94994) Simulation of coastal flow fields when the incident solar radiation is obscured.** Molenkamp, C.R. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 11p. (CONF-870358—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003469.

From International conference on energy transformation and interaction with small and mesoscale atmospheric processes; Lausanne, Switzerland (2 Mar 1987).

In the aftermath of a large scale nuclear exchange, smoke from fires started by the explosions would be lofted into the troposphere and lower stratosphere. If sufficient amounts are injected, this smoke would be so thick that very little solar radiation would penetrate to the ground. The ground surface, obscured from insolation by the smoke, would cool rapidly leading to temperature decreases of 10 to 25°C in the lower atmosphere. Among the many possible effects accompanying this cooling, a suggestion has been made that regions of enhanced and persistent precipitation could occur along continental coastlines due to the response of the flow fields to the more rapid cooling of air over land than over the oceans. This paper describes a simulation intended to investigate this super land breeze hypothesis using a mesoscale model that has been used to simulate normal land and sea breeze flows. The simulation shows that fog and clouds form over both land and sea with the net result that there is no dramatic temperature difference at the continental coastline and no significant induced flow or vertical motion. This simulation again contravenes the super land breeze precipitation hypothesis. In addition, it points out the moderating effect cloud and fog formation would have on the rate of cooling over the continents.

12230 **Chemical lasers.** Miller, J. (TRW Redondo Beach, CA). *Journal of Fusion Energy;* **5**: No. 1, 41-50(Mar 1986). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

The author discusses the chemical laser as having an application principally for strategic defense. The lasers provide for self-contained, space-based systems with reactant storage, laser, and optics all integrated into a single space-based system. The development of chemical lasers is discussed and illustrations are provided. Large scale chemical lasers have been built which are efficient and operate reliably. Applications involve discrimination as well as ballistic missile booster intercept. Research is underway to extend chemical lasers into space-based systems on behalf of strategic defense. Involved are the hydrogen fluoride lasers in general, the project ALPHA in particular, and the shorter wavelength chemical lasers in the more advanced research area.

12231 **The issues faced by the SDI.** Yonas, G. (SDI Organization, Defense Dept., Washington, DC). *Journal of Fusion Energy;* **5**: No. 1, 13-16(Mar 1986). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

The author discusses issues faced by the Strategic Defense Initiative (SDI), in particular that before proceeding with a commitment to a defensive system, we must be convinced not only that it will work but that it will work against a determined and responsive offense. The author stresses defining the cost exchange for countermeasures and missile proliferation, and estimating whether and how rapidly an adversary might employ such options. The author examines the nature of defense requirements in terms of defensive phases or tiers; that at each defensive tier the defense must carry out a set of essential functions: acquistion and discrimination, interception and destruction, and battle management. The essence of the author's research program is to investigate technologies that would lead to defenses cheaper and easier than the steps to overcome and defeat them.

12232 **The strategic defense initiative: Start of a new era in national defense.** Keyworth, G.A. (Office of Science and Technology, Washington, DC). *Journal of Fusion Energy;* **5**: No. 1, 7-12(Mar 1986). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

The author discusses the historical background which led to the President's decision two years ago in regard to the Strategic Defense Initiative (SDI) and also looks into the future to contemplate some of the impacts of SDI. The author emphasizes that the SDI is strictly a research and development program whose objective is to investigate a number of highly promising technologies that could evolve into parts of a defense system. He explains that the objective is to be able, within a few years, to demonstrate feasible options by which we might effectively defend the United States and its allies against ballistic missiles.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 12538, 12539, 12540, 12541, 12542, 12543, 12544, 12545

12233 **(AD-A—172543/1/XAB) Hydrophone investigations of earthquake and explosion generated high-frequency seismic phases. Final report, October 1983-September 1985.** Walker, D.A. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). 30 Apr 1986. 320p. NTIS, PC A14/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Data from the Wake Island Hydrophone Array was used in studies related to the detection and discrimination of underground nuclear explosions. These include: (1) comparative studies of explosion phases from sites at comparable epicentral distances in the highly efficient propagational distance range of 60 to 90°; (2) some preliminary estimates of detection level thresholds; (3) estimates of deep ocean noise levels and comparisons to quiet continental sites; (4) determinations of the stability of yield estimates; and (5) the location of significant earthquakes unreported by both the NEIS and ISC, but well-recorded at great distances by elements of the Wake array, in the interior and along the subducting margins of the Western Pacific Basin. The unreported earthquakes in the southwest Pacific have led, in part, to the discovery of a new subduction zone - the Micronesian Trench. Unreported earthquakes in the interior of the basin and along its subducting margins may also have associated gravitational effects of Air Force relevance. Finally, data from the Wake array has been useful in a partial resolution of the reported mystery cloud of 9 April 1984 and in the analysis of T-phases from underground explosions in the Tuamotus.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 11103, 11193, 11825, 11830, 12243

12234 **(ECN—186) Import and export of acid pollution in the Netherlands.** Asman, W.A.; Buijsman, E.; Vermetten, A.; Ten Brink, H.M.; Heijboer, R.J.; Janssen, A.J.; Slanina, J. (Netherlands Energy Research Foundation, Petten; Rijksuniversiteit Utrecht (Netherlands). Inst. voor Meteorologie en Oceanografie). Sep 1986. 95p. (In Dutch). (IMOU-R—86-10). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A long-range transport model (IE-model) was developed for sulfur oxides and nitrogen oxides. Transfrontier pollution was calculated for The Netherlands. Calculated concentrations in air and precipitation are compared with measured concentrations. Some conclusions of this investigation are: 75% of the acid deposition in The Netherlands is of foreign origin; the model predicts wet acid deposition and atmospheric concentrations of sulfate, nitrate and sulfur dioxide rather exactly. NO/sub x/-concentrations are predicted less satisfactory. Tables and figures give details of input data and calculated results. 53 refs.

12235 **(RISO-R—467) Oeresund-experiment - meteorological measurements (masts, turbulence, mini-sondes) performed by Risoe National Laboratory.** Gryning, S.-E.; Gylling Mortensen, N. (Risoe National Lab., Roskilde (Denmark)). Jan 1986. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87750610.

This report describes the measurements carried out by Risoe National Laboratory as part of the Oeresund experiment. Measurements were made of 1) turbulence at the Gladsaxe mast during tracer releases, 2) profiles of wind and temperature at four small masts and at the Risoe mast; by application of current flux profile relationship estimates of the momentum and sensible heat flux can be calculated, and 3) profiles of tempeature, wetbulb temperature and pressure by a mini-radiosonde-system (AIRSONDE), the sondes were launched from a fishing boat at various positions in Oeresund during tracer releases. The report also describes measurements of temperature with a so-called Sprenger-radiosonde-system. All radiosonde measur ments described in this report were carried out by the Swedish Meteorological and Hydrological Institute. The Sprenger-sondes were launched from the fishing-boat in between the AIRSONDES. The report contains a technical description of the instruments that were used and of their position and performance during the experiment. Most of the measurements are illustrated in figures and tables.

12236 **(AD-A—172820/3/XAB) Study on features of flow field and atmospheric dispersion parameters in mountainous area by balanced balloons.** Weimei; Chaofu; Yunxian; Zongkai; Zengwang. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 10 Sep 1986. Translated from Huanjing Kenxue Xuebao (China), Vol. 6, No. 2, 212-218(Jun 1985). (FTD-ID(RS)T—0694-86). 19p. NTIS, PC A02/MF A01.

Study results of flow-field features and atmospheric-diffusion parameters are described. The analysis shows that there are some obvious and significant flow patterns in mountainous area, such as valley breeze, channel wind, fumigation, and thermal effect of industrial sources etc. The parameters in three dimensions were obtained by probing on site. Some of the problems associated with the calculation of parameters by the method of sliding average using limited number of data are discussed. By using mathematical simulation, the relationship between sampling time and time interval of the sliding average was analyzed.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 10731, 10758, 10763, 10798, 10802, 11181, 11191, 11439, 11906, 12234, 12279, 12292, 12293, 12325, 12517, 12524, 12525

12237 **(AD-A—172683/5/XAB) Airborne CO_2 dial (differential absorption lidar) measurement of atmospheric tracer gas concentration distributions.** Uthe, E.E. (SRI International, Menlo Park, CA (USA)). 1 Aug 1986. 8p. NTIS, PC A02/MF A01.

An airborne differential absorption lidar system employing high-energy line-tunable CO_2 lasers has been used to map crossplume vertical distributions resulting from a near-surface SF_6 tracer gas-release. The remote SF_6 tracer measurement technique may be suitable to evaluate distributions of toxic and hazardous materials accidentally released into the atmosphere providing tracer gas is also released during the accident. The technique also may provide transport and diffusion data needed for development and validation of atmospheric computational models that predict downwind distribution of materials released into the atmosphere.

12238 **(AD-A—172886/4/XAB) Development and demonstration of ALARM (airborne lidar agent remote monitor). Final report.** Uthe, E.E.; Morley, B.M.; Nielsen, N.B. (SRI International, Menlo Park, CA (USA). Atmospheric Science Center). Aug 1986. 125p. NTIS, PC A06/MF A01.

An airborne wavelength-tunable CO_2 differential absorption lidar (DIAL) capable of making simultaneous measurements of atmosphe4ric backscatter and surface-reflected energy was developed and tested in a series of experiments. A data base of surface returns for a flight track that passed over ocean, farmland, urban, forest and grassland surfaces was collected for various lidar wavelengths and wavelength separations. The data show that highest correlation between two-wavelength surface returns occurs over land surfaces and the highest decorrelation over ocean surfaces-the DIAL sensitivity for detection of chemical agents based on surface returns is significantly better over land than ocean areas. The data also show that the highest decorrelation is associated with the highest reflectivity surfaces of ocean and urban areas, probably a result of specular reflection. The correlation of surface returns decreases with increasing wavelength separation over land areas but is nearly independent of wavelength separation over ocean areas. The airborne DIAL system was demonstrated for mapping the crossplume gas concentration distribution resulting from a near-surface release of SF_6. A new Fourier-analysis method was used to improve single pulse-pair signal-to-noise ratios.

12239 **(BNL—38800) Processes determining cloudwater composition: Inferences from field measurements.** Daum, P.H. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 26p. (CONF-8609193—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001463.

From NATO advanced research workshop on acid deposition processes at high elevation sites; Edinburgh, UK (8 Sep 1986).

Mechanisms considered for the composition of cloudwater include: (1) nucleation scavenging of aerosol; (2) scavenging of soluble gases; and (3) reactive scavenging of less soluble gases. The efficiency of aerosol scavenging by nucleation was examined by use of a variety of physical and chemical techniques. The data are consistent with essentially complete (>90%) scavenging of both particle mass and sulfate by cloudwater. Similarly, comparisons of interstitial HNO_3 and cloudwater nitrate concentrations are consistent with essentially complete scavenging of nitric acid by cloud droplets. Studies of reactive scavenging focussed on the aqueous phase reactions of SO_2 with H_2O_2 and O_3. Measurements suggest that the O_3/SO_2 reaction is slow with respect to cloud lifetimes; the H_2O_2/SO_2 reaction appears to be rapid for representative atmospheric conditions. H_2O_2 concentrations ranged from less than 0.1 μM to 100 μM; equivalent gas phase concentrations from aqueous phase concentrations, cloud liquid water content, and H_2O_2 solubility typically ranged from less than 0.05 ppB and 1 ppB during the summer, and less than 0.05 ppB during winter. A strong negative correlation between H_2O_2 and interstitial SO_2 concentrations is consistent with the rapid and quantitative in-cloud reaction of SO_2 with

H_2O_2 in which either these species acts as the limiting reagent. Low level stratus clouds in winter exhibited high concentrations of interstitial SO_2 and very low concentrations of cloudwater H_2O_2. No direct evidence for in-cloud oxidation of NO or NO_2 to HNO_3 was found.

12240 **(BNL—38847) Perfluorocarbon tracer technology.** Dietz, R.N. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 34p. (CONF-8609215—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003213.

From Ispra courses: regional and long-range transport of air pollution; Ispra, Varese, Italy (15 Sep 1986).

Perfluorocarbon tracer technology developments at Brookhaven is described, including the latest identified as well as available PFTs and air sampling and analysis tools, to demonstrate their utility in a number of different atmospheric tracer experiments as well as in other applications, and to provide food-for-thought on new ways in which the PFTs can be applied in other research objectives. All of the important tools are described, but emphasis is given to the latest developments in the technology.

12241 **(CONF-860467—Summ.) Report on the materials effects research review meeting of the National Acid Precipitation Assessment Program.** Joyner, K.C.; Schnell, M.H. (North Carolina State Univ., Raleigh (USA). Acid Deposition Program). Oct 1986. 110p. North Carolina State Univ., Acid Deposition Program, 1509 Varsity Drive, Raleigh, NC 27606. File Number TI87900096.

From Peer review of task group G on effects on materials of the National Acid Precipitation Assessment Program; Durham, NC, USA (7 Apr 1986).

Invited panels of scientists and other technical experts reviewed 30 projects, basing their evaluations on oral presentations at the meeting and written summaries received by the reviewers before the meeting. Projects were reviewed for quality of science as well as relevance to the overall program objectives for use by NAPAP program and research managers to improve and coordinate current research and set priorities for research between 1988 and 1990 in the following: economics and behavior; cultural inventory; construction inventory; air quality; damage functions, paint; damage functions, metal; and damage functions, stone. In addition, three generalist reviewers were asked to comment on the overall Task Group VII effort including its various components. This document is a compilation of the summary reports, consisting of general comments and comments on individual projects, submitted by each review panel, and the written comments from the generalist reviewers.

12242 **(CORR—85-00484) Stationary source sampling report: Volatile organic compounds testing, 300-M area air stripper exhaust stack.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 25 Nov 1985. Contract AC09-76SR00001. 37p. NTIS MF A01; 2; GPO Dep. File Number DE87003115.

An air stripping column was used in the 300-M area to remove volatile organic compounds from contaminated groundwater. Tests were performed October 29, 1985, at the air stripper exhaust stack to measure the emissions of tetrachloroethylene, trichloroethylene, and 1,1,1-trichloroethane for compliance purposes. Three absorbent sampling train (AST) runs (yielding duplicate samples for each run) and three velocity traverses were performed at the air stripper exhaust stack. Ambient air sampling was not performed as scheduled because of inclement weather conditions.

12243 **(DOE/ER/60316—T1) Studies of climatic variability during the period of instrumental records: Second annual report.** Goodess, C.M.; Bradley, R.S.; Kelly, P.M.; Jones, P.D.; Diaz, H.F. (Massachusetts Univ., Amherst (USA); East Anglia Univ. (UK). Climatic Research Unit; National Oceanic and Atmospheric Administration, Boulder, CO (USA). Environmental Research Labs.). Nov 1986. Contract FG02-85ER60316. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003694.

The aim was to analyze the Department of Energy long-term climatic data bank to investigate the carbon dioxide-climate question. In the second year of the study, the focus was on: (1) analysis of long-term precipitation for Northern Hemisphere land areas; (2) evaluation of the influence of various forcing factors on the temperature and precipitation record of the last 130 years; (3) analysis of the Comprehensive Ocean-Atmosphere Data Set (COADS) and merging with the DOE land data set; and (4) analysis of the effects of the El Nino/Southern Oscillation (ENSO) phenomenon on the temperature and precipitation variability of the Northern Hemisphere land areas.

12244 **(DOE/NBB—0081) Uncertainty in future global energy use and fossil fuel CO_2 emissions, 1975 to 2075.** Edmonds, J.A.; Reilly, J.M.; Gardner, R.H.; Brenkert, A. (Pacific Northwest Lab., Richland, WA (USA); Oak Ridge National Lab., TN (USA); Science Applications International Corp., Oak Ridge, TN (USA)). Dec 1986. Contract AC05-76OR00033. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003699.

This report documents the results of work with the IEA/ORAU Long-Term Global Energy-CO_2 model to analyze model predictions of future global carbon emissions from fossil fuel use and the uncertainty surrounding such forecasts. The methodology utilized state-of-the-art techniques of uncertainty analysis along with review and revision of the IAE/ORAU model structure, and review and description of uncertainty surrounding model assumptions and parameters to explore uncertainty in fossil fuel CO_2 emissions over the period 1975-2075. Possible interrelationships among assumptions and parameters, and their effects on overall forecast uncertainty are explored. The major findings include: (1) the median rate of CO_2 emissions grow at an average annual rate of 1.0% per year; (2) overall uncertainty in the emission rate was found to be considerable; (3) low and declining CO_2 emissions rates appear more likely than past research has indicated; (4) the three most important determinants of variation in CO_2 emissions were labor productivity, rate of improvement in end-use energy efficiency, and the income elasticity of demand of energy in the developing world; (5) based on the analysis of potential correlation among assumptions, model structure plays a key role in the determination of median estimates of fossil fuel CO_2 for energy emissions; and (6) conspicuously absent from the list of key variables were the rate of interfuel substitution and the fossil fuel resource base by fuel type.

12245 **(DOE/PC/80540—T6) Emission control equipment for residential coal-fire stove: Final project.** Bryant, B.A.; Turay, J.S.; Eckels, A. (North Carolina Central Univ., Durham (USA)). 15 Dec 1986. Contract FG22-85PC80540. 21p. NTIS, PC A02. File Number DE87003349.

This project examined the effectiveness of SO_2, CO, and particulate control emission measures for residential coal stoves.

12246 **(ECN—187) Effective removal parameters in long-range transport models, derived from diffusion theory calculations.** Janssen, A.J.; Asman, W.A. (Netherlands Energy Research Foundation, Petten; Rijksuniversiteit Utrecht (Netherlands). Inst. voor Meteorologie en Oceanografie). Sep 1986. 34p. (IMOU-R—86-15). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In simple Lagrangian long-range transport models used for air pollution studies turbulent mixing is described in a very approximate way. This description has the effect that calculated concentrations and deposition patterns may not be realistic. However, correction factors, derived from more detailed diffusion calculations, can be introduced easily into these simple models to get an adequate description of the mixing process. If such correction factors are applied in simple models, the increase in computing time is negligible, whereas the results are about as good as those of more sophisticated models which need much more computing time. This report describes how the necessary correction factors can be put into a simple model and how a reactive diffusion model is used to derive the values of these factors. Calculated values are given for the pollutants NH/sub 3/, SO/sub 2/ and NO/sub x/ and for their reaction products NH/sub 4//sup +/, SO/sub 4//sup 2-/ and NO/sub 3//sup -/, respectively. Sensitivity calculations are made and results are compared with the results of other diffusion models.

12247 **(KFK-PEF—4(Vol.3)) Project European Research Center for Air Pollution Abatement Measures.** Horsch, F.; Filby, G.; Fund, N.; Gross, S.; Hanisch, B.; Kilz, E.; Seidel, A. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Apr 1986. 259p. (In German). (CONF-8603154—Vol.3). NTIS (US Sales Only), PC A12/MF A01. File Number DE87750298.

From 2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe; Karlsruhe, F.R. Germany (4 Mar 1986).

This third volume of the PEF status report comprises three parts with contributions on the following topics: (1) Development and optimisation of economically and technically efficient methods for prevention or reduction of emissions. (2) Elaboration of organisational, legal or other instruments and recommendations for dealing with the economic and political aspects of the problems involved. (3) Air pollution and its effects on man and the respiratory system. Individual subject analyses of each of the 16 papers of the report are available in the database.

12248 **(KNMI-WR—6-1) Dry deposition parameterization in long range transport models.** Kulig, A. (Royal Netherlands Meteorological Inst., Der Bilt). 1986. 39p. (B—8666193; ETN—86-98501). NTIS, PC A03/MF A01.

Methods for the computation of surface deposition velocities of sulfur and nitrogen dioxide, and sulfate and nitrate particles are derived. The methods may be used in studies of long range (mesoscale and regional scale) pollution transport. The influence of friction velocity and stability of the atmosphere on aerodynamic resistance is discussed. The standard deposition velocities which consist of the surface resistance and resistance of the laminar sublayer adjacent to the surface, are estimated. Mean values of dry deposition velocities for terrain categories useful in long range transport models are proposed.

12249 **(MST-LUFT-A—102) DK-EMEP bulletin 1978-1982. A five-year overview of rural air pollution in Denmark.** Heidam, N.Z. (Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab.). Feb 1986. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87750597.

A survey of 5 years of daily measurements of pollution concentrations at three Danish EMEP stations, two in Denmark proper and one at the Faroe Islands has been carried out. For precipitation in Denmark proper it was found that acidity and concentrations of ammonium are very much alike at the two stations, but that concentrations of sulfate and nitrate are somewhat higher at the station bordering on the Baltic Sea compared to the rural inland station. The wet depositions of hydrogen ions and sulfate are quite similar, the deposition of ammonium is higher and that of nitrate is lower at the rural inland station as compared to the coastal station. At the Faroe Islands, where bulk collection is used, the levels are lower than in Denmark by a factor of 2 or more. The concentrations of airborne particulate sulfur and ammonium and of sulfurdioxide are quite similar at the two Danish stations. For the two individual stations the daily concentrations of sulfate and ammonium were highly correlated but a surplus of ammonium with respect to ammoniumsulfate appeared to be present, possibly caused by excess ammonia attached to other ions. At the Faroe Islands the airborne particulate sulfate was corrected approximately for the dominant marine contribution by using PIXE results on sulfur and chlorine. By this means an overall difference between total and non-marine sulfate was found to amount to a factor of about 2.5, indicating that the calcualted sulfate value is rather uncertain.

12250 **(PB—87-106480/XAB) Health-hazard evaluation report HETA 85-083-1705, Summit Finishing Company, Inc., Mooresville, Indiana.** Daniels, W.J.; Kramkowski, R.S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1986. 26p. (HETA—85-083-1705). NTIS, PC A03/MF A01.

An evaluation of employee exposures to chemicals used in electroplating operations was made. At the time of the study there were 67 employees, about 26 of whom were involved directly in the production operations. Airborne concentrations of perchloroethylene did not exceed OSHA standards, but they did exceed the NIOSH recommended exposure level on both a ceiling and time weighted average basis. Environmental samples collected for cyanides, inorganic acids, metals, and formaldehyde were below their respective evaluation criteria at the time of the survey. The authors conclude that a potential health hazard existed from exposures to perchloroethlyene. A significant number of employees reported acute mucous membrane irritation. The authors made recommendations.

12251 **(PB—87-106514/XAB) Health-hazard evaluation report HETA 84-248-1694, Wasson Elementary School, Dubois, Pennsylvania.** Gorman, R.; Aw, T.C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 26p. (HETA—84-248-1694). NTIS, PC A03/MF A01.

The DuBois area school district DuBois, Pennsylvania requested an evaluation due to complaints of bloody nose, dry eyes, upper respiratory irritation, and headaches among students and faculty at the Wasson Elementary School. All 24 teachers were involved in a questionnaire that focused on medical histories and symptoms related to working in the school. Environmental air samples revealed trace concentrations of organic vapors, primarily toluene and C9 to C12 hydrocarbons. Carbon-dioxide levels measured 200 parts per million (ppm) outside and up to 800 ppm inside, suggesting that the amount of fresh air coming into the building was inadequate. The distribution of that air within the building was inadequate. The authors conclude that the health complaints were related to poor indoor air quality caused by deficiencies in the ventilation system. The heating/cooling system had many deficiencies related to design, installation, and maintenance. The authors recommended improvements to be made in the system, including cleaning air filters, adjusting dampers, leaving classroom doors open, using fans to promote mixing of outside air, and setting thermostats at the same setting.

12252 **(PB—87-107033/XAB) Health hazard evaluation report HETA 85-030-1693, Fruehauf Corporation - Parts Plant, Delphos, Ohio.** Gorman, R.; Ehrenberg, R.; Hunninen, K. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1986. 28p. (HETA—85-030-1693). NTIS, PC A03/MF A01.

A request was received from union and management at the Fruehauf Corporations Parts Facility in Delphos, Ohio to evaluate possible exposures to total welding fume, metals, carbon-monoxide, oxides of nitrogen, and ozone during welding operations. Total welding fume concentrations in 32 personal breathing zone samples ranged from 1.5 to 23.4 milligrams per cubic meter (mg/m^3). Nine area samples ranged from 0.4 to 3.7mg/m^3. Three sample results exceeded OSHA standard of 15mg/m^3. Iron was the predominant metal found. Measurable quantities of aluminum, chromium, copper, magnesium, manganese, molybdenum, nickel, lead, tin, and vanadium were found. Results of a questionnaire, given to 33 of the 92 welders, indicated a relatively high prevalence of reported symptoms of mucous membrane and respiratory tract irritation, including eye irritation, sinus/nasal congestion, headaches, throat irritation and cough.

12253 **(PB—87-108023/XAB) Health-hazard evaluation report HETA 85-407-1692, Parkway Products, Inc., Cincinnati, Ohio.** Osorio, A.M.; Clapp, D.E.; Ward, E.; Thun, M.; Halperin, W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 31p. (HETA—85-407-1692). NTIS, PC A03/MF A01.

The management of Parkway Products, Inc., Cincinnati, Ohio, requested an evaluation of one worker exposed to 4,4'-methylene-bis-2-chloroaniline (MBOCA) while cleaning out a machine that mixes MBOCA with a polymer resin. Medical and occupational histories, dermatological exam, serial serum liver and renal function tests, urinalyses, and urine MBOCA levels were obtained from this worker, a urethane molder. Urine MBOCA levels ranged from 1707 parts per billion 9 hours after the accident to nondetectable 11 days later. An environmental evaluation was also made at the facility. The authors conclude that the MBOCA exposure experienced by this worker did not result in any acute medical condition, but that long term effects cannot be predicted. Also recommended

were: an evaluation of the current ventilation and isolation of MBOCA processes; frequently washing the MBOCA operating areas; enforcing the daily change in protective workclothes; enforcing use of impermeable gloves and safety goggles; encouraging showering of all exposed workers, and continued periodic safety meetings.

12254 **(PB—87-108031/XAB) Health-hazard evaluation report HETA 85-329-1708, R. T. French Company, Springfield, Missouri.** Carson, G.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1986. 17p. (HETA—85-329-1708). NTIS, PC A02/MF A01.

An evaluation of workers exposure to ethylene oxide and methyl bromide was made. The facility employs 375 workers and was established exclusively for spice handling and manufacturing. Thirteen personal air samples for ethylene oxide ranged in concentration from .01 to 1.07 parts per million (ppm). The three samples which exceeded the OSHA standard of 1 ppm were from workers unloading sacks of sterilized spices from inside trucks. Twelve environmental air samples for ethylene oxide ranged from less than .01 to 15 ppm, with the highest being obtained from inside the trucks during unloading operations. No methyl-bromide was detected in personal samples on the packaging line and the two area samples on top of the tote bins in the fumigation room showed 12.5 and 45 ppm. The author concludes that uncontrolled conditions which exist may result in exposure to the compounds; during this survey, the levels to which workers were exposed would not represent a health hazard. It is recommended that a means be devised to ventilate the trucks carrying spices during the trip from the contract sterilizer.

12255 **(PB—87-108049/XAB) Health-hazard evaluation report HETA 85-105-1689, Fibre-Glast Development Corporation, Dayton, Ohio.** Zey, J.M.; Anastas, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 30p. (HETA—85-105-1689). NTIS, PC A03/MF A01.

An evaluation was made concerning potential exposures of 1 or 2 employees during production of fibrous glass repair kits. Air samples were assessed for possible exposures to methylenechloride, butyl-cellosolve, styrene, general organics, total and respirable particulates, and carbon dioxide. Methylene chloride concentrations of 443 and 460 were found in 80-minute samples taken during cleaning of a mixer with methylene chloride. NIOSH recommends that exposures to methylene chloride should be reduced to the lowest feasible level. Organic vapors including methylene chloride were migrating into the office area from the production area of the facility. The authors conclude that a health hazard exists for exposure to methylene chloride. The authors recommend either substitution of a different solvent or the institution of more rigid engineering controls. Airborne concentrations of methylene chloride in the compounding, repacking, and office areas should be reduced.

12256 **(PB—87-108056/XAB) Health-hazard evaluation report HETA 84-510-1691, Rockwell International, Rocky Flats Plant, Golden, Colorado.** Gunter, B.J.; Thoburn, T.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 31p. (HETA—84-510-1691). NTIS, PC A03/MF A01.

An evaluation of worker exposure to beryllium at the Rocky Flats Facility was made. Six of 33 breathing-zone air samples collected for beryllium analysis showed levels exceeding the NIOSH evaluation criterion of 0.5 micrograms/cubic meter (microg/m^3). These samples ranged from 7.2 to 0.57microg/m^3. Thirty-three samples collected on beryllium machining equipment were at or below 0.5micro/m^3. Breathing-zone air samples were taken on all 8 workers and the foreman in the beryllium shop and seven of the nine samples exceeded the 0.5 microg/m^3 level, ranging from 0.5 to 2.1microg/m^3. Most of these nine workers had normal pulmonary function. Two had a severity code other than zero. Neither had worked in the beryllium shop for more than a year and the more severely affected had only recently started, but had a history of pulmonary disease. The authors conclude that a health hazard exists from overexposure to beryllium existed in the beryllium shop. Recommendations were given by the authors.

12257 **(PB—87-108064/XAB) Health0hazard evaluation report HETA 84-132-1703, Purex Industrial Division, Marion, Ohio.** Stephenson, R.L.; Aw, T.C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1986. 27p. (HETA—84-132-1703). NTIS, PC A03/MF A01.

Due to reports of employee symptoms of headaches, irritation of the nose, throat and respiratory tract, and muscular weakness, possible chemical exposures during the manufacturing and packaging of various institutional and janitorial maintenance chemicals and allied products at the Purex Industrial Division Facility, Ohio were evaluated. Long-term personal breathing zone air samples revealed: acetone, 104 milligrams/cubic meter (mg/m^3) to 939 mg/m^3; ammonia, not detectable to 68.8 mg/m^3; ethanolamine, 1.5 mg/m^3; methylene-chloride, 171 to 561 mg/m^3; sodium-hydroxide, 0.4 to 1.3 mg/m^3; and styrene, 6.0 to 66.9 mg/m^3. No detectable airborne concentrations of butyl cellosolve formaldehyde, or morpholine were found. The author concludes that during the survey, employees were overexposed to ammonia and methylene-chloride.

12258 **(PB—87-108320/XAB) Health-hazard evaluation report HETA 84-415-1688, Precision Castparts Corporation, Portland, Oregon.** Ratcliffe, J.M.; Clapp, D.E.; Schrader, S.M.; Turner, T.W.; Oser, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 37p. (HETA—84-415-1688). NTIS, PC A03/MF A01.

A cross-sectional evaluation of semen quality (sperm concentration, pH, volume, viability, motility, velocity and morphology) was made among men employed at the Precision Castparts Corporation, Portland, Oregon in response to a management request to evaluate effects of exposure to 2-ethoxyethanol (2EE). About 80 male workers were potentially exposed to 2EE, used as a binder in investment casting. Full-shift breathing-zone airborne exposures to 2EE ranged from not detectable to 23.8 ppm. The average sperm count per ejaculate among the exposed workers was significantly lower than that of the unexposed comparison group, 113 versus 154 million sperm/ejaculate. Average sperm concentrations of both groups were significantly lower than the average for other occupational populations. The authors conclude that there is a possible effect of 2EE exposure on sperm count among these workers, but other factors may be affecting semen quality of both exposed and unexposed workers.

12259 **(PB—87-108346/XAB) Walk-through survey report of General Dynamics, Fort Worth, Texas.** Zaebst, D.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1986. 23p. (IWS—134.15). NTIS, PC A02/MF A01.

A walk-through survey was conducted to evaluate painters' exposures to glycol ethers at the General Dynamics military aircraft manufacturing facility, Fort Worth, Texas. Personal breathing-zone exposures to airborne 2-ethoxyethyl-acetate (2-EEA) averaged 1.30 parts per million (ppm). The highest individual exposure was 6ppm. The current OSHA standard is 100ppm. Results of two surveys of major painting areas indicated that painters' exposures to 2-EEA ranged from 0.48 to 2.8ppm, from 0.1 to 7.49ppm, and from 1.5 to 12.1ppm in the three areas. Due to the use of respiratory protection by many of the painters, actual inhalation exposures were undoubtedly much lower than the breathing-zone measurements. Some exposure may have been incurred through skin absorption. The authors recommend that an additional industrial hygiene survey, including urine monitoring and air monitoring should be carried out in order to obtain a better estimate of total exposure to 2-EEA.

12260 **(PNL-SA—13806) Model simulation of plume dispersion in a narrow valley after sunrise.** Bader, D.C.; Whiteman, C.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 5p. (CONF-861165—6). NTIS, PC A02. File Number DE87003305.

From 5. joint conference on applications of air pollution meteorology; Chapel Hill, NC, USA (18 Nov 1986).

We report on numerical simulations of cross-valley plume dispersion in a strongly asymmetrically heated valley and compare those results to measurments. Additionally, we use the model re-

sults to describe the boundary layer mechanisms responsible for the observed plume structure and to examine the effects of pollutant release height on cross-valley dispersion patterns.

12261 **(UCRL—95645) The effect of aging on smoke optical properties and scavenging characteristics.** Penner, J.E. (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 18p. (CONF-861194—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002757.

From DNA workshop on smoke emissions and properties; Gaithersburg, MD, USA (13 Nov 1986).

Aging of smoke in dense smoke plumes is known to alter its size distribution and scavenging characteristics. In this paper, I review data pertaining to these processes and compare them to model simulations of the coagulation of smoke. Model simulations of the degree of smoke coagulation in the first few days after a nuclear war are summarized. The predicted size of smoke particles after several days of coagulation is found to be larger than that of any data pertaining to the absorption properties of smoke. Thus, it is suggested that more relevant data on the absorption properties of smoke is needed. I also review aging experiments pertaining to the number of cloud condensation nuclei in a smoke sample. I show that the fraction of smoke particles which act as CCN after aging depends on the number of particles initially present in the aging chamber. Smoke from an acetylene flame can quickly coagulate to sizes wherein nearly all of the particles act as CCN. On the other hand, only 10% of the smoke particles from an outdoor fire of gasoline and diesel fuel became CCN after 30 hours of aging. The development of CCN concentrations in this experiment may have been quenched by low initial concentrations in the aging chamber. Both experiments are consistent with particles as small as 0.08 micron in radius (and perhaps even smaller) acting as CCN. Model simulations of the coagulation of smoke particles above a large, intense fire show that coagulation would allow approximately 50% of the particles to become larger than 0.08 micron before the plume reaches cloud base. Furthermore, aging over several days time would transform nearly all the particles into the scavengable size range.

12262 **Multimedia design principles applied to the development of the global baseline integrated monitoring network.** Wiersma, G.B.; Otis, M.D. (Idaho National Engineering Laboratory, Idaho Falls, ID). pp 317-332 of Pollutants in a multimedia environment. Cohen, Y. New York; Plenum Press (1986). (CONF-860156—).

From 1. workshop on pollutant transport and accumulation in a multimedia environment; Los Angeles, CA, USA (22 Jan 1986).

A global background monitoring network for making estimates of pollutant levels and estimates of compounds that have natural as well as man-made reference levels is being developed. This program is being developed through use of a multimedia systems approach. This paper will deal with the design of the project, a description of the current pilot project, and a discussion of the future implementation of the entire global project. Emphasis will be on the value of the use of a systems approach in designing and evaluating an environmental monitoring program on a global scale. This paper describes, in particular, the results of studies at Glacier National Park and the application of kinetic models to design and analyze a multimedia environmental monitoring system in a remote area.

12263 **Application of multimedia pollutant transport models to risk analysis.** McKone, T.E.; Kastenberg, W.E. (Lawrence Livermore National Laboratory, Livermore, CA). pp 167-189 of Pollutants in a multimedia environment. Cohen, Y. New York; Plenum Press (1986). (CONF-860156—).

From 1. workshop on pollutant transport and accumulation in a multimedia environment; Los Angeles, CA, USA (22 Jan 1986).

This paper will explore how multimedia transport models can be used in an environmental health risk analysis. Multimedia models offer a way of organizing information about landscape and chemical properties in order to provide a comprehensive picture of the link between source and receptor for toxic chemicals. An overview of the risk analysis process is given, including risk assessment and management. A description of a multimedia model called GEOTOX which was developed for use in evaluating the health risks of trace elements, radionuclides and organic chemicals, is also provided. The authors demonstrate the use of GEOTOX by a sample application to three chemicals, and they examine how these models can be used in risk assessment to better define the relationship between contaminant releases and resulting doses to humans.

12264 **Unified transport model for organics.** Patterson, M.R. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 93-115 of Pollutants in a multimedia environment. Cohen, Y. New York; Plenum Press (1986). (CONF-860156—).

From 1. workshop on pollutant transport and accumulation in a multimedia environment; Los Angeles, CA, USA (22 Jan 1986).

The Unified Transport Model UTM-TOX is a computer simulation model funded by the USEPA at the Oak Ridge National Laboratory to develop transport capabilities for new chemicals and pesticides that are organic in nature. The model combines atmospheric transport with hydrologic transport and couples sediment transport, plant growth models and biodegradation within one unified package. In all of the cases to which the UTM-TOX model has been applied it has yielded information that was useful to the researchers studying the Walker Branch watershed at ORNL. It has allowed greater insight into the processes which mediate the transport and the fate of those pollutants that the model is designed to handle. It provides a vehicle for calculation of the concentration of a toxicant in many compartments of the ecosystem.

12265 **Assessment of inhalation and ingestion population exposures from incinerated hazardous wastes.** Travis, C.C.; Holton, G.A.; Etnier, E.L.; Cook, C.; O'Donnell, F.R.; Hetrick, D.M.; Dixon, E. (JBF Associates, Inc., Knoxville, TN). *Environment International;* **12**: No. 5, 533-540(1986). Contract AC05-84OR21400.

This assessment makes a preliminary determination of the relative importance of the air and food chain pathways of human exposure to hazardous materials released from hazardous waste incineration facilities. Identical 4400 kw (150 x 10^6 Btu/h) rotary kiln incinerators burning pesticide-related wastes were assumed to be sited in three different U.S. locations. Individual exposures resulting from incineration of the 10 most prevalent pesticide-related chemicals currently being incinerated in the U.S. were estimated. Results indicate that the food chain pathway may be an important contributor to total human exposure from incineration of hazardous wastes.

5003 Radioactive Materials Monitoring And Transport

12266 **(AD-A—172720/5/XAB) Reduction of radon progeny in indoor air. Master's thesis.** Weidner, J.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 83p. (AFIT/GNE/ENP—86M-13). NTIS, PC A05/MF A01.

The effectiveness of using three different types of air-treatment methods to reduce the concentrations of radon progeny in a residence was evaluated. The air-treatment devices were two types of electrostatic precipitators designed for use with a whole-house heating and cooling system and an ionization air cleaner designed for table-top use in a single room. The air-treatment devices were tested in a 100-m^3 chamber at typical radon gas concentrations of 12.5 to 20.5 picocuries per liter. The modified Tsivoglou method was used to determine radon progeny concentrations and a continuous monitor for radon concentration was in operation, allowing calculation of the equilibrium factor under non-constant radon conditions. Reduction in average working-level measurements and reduction in equilibrium factor were used to evaluate the effectiveness of the air treatments. Radon progeny reductions of greater than 50% were observed for all three devices tested at air-treatment rates comparable to those that would be used in a residence.

12267 **(EGG—10282-1110) An aerial radiological survey of the Browns Ferry Nuclear Power Station and surrounding area, Decatur, Alabama.** Berry, H.A. (EG and G Energy Measurements, Inc., Las Vegas, NV (USA)). Oct 1986. Contract AC08-83NV10282. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003409.

An aerial radiological survey was conducted during the period 12 July to 17 July 1985 over a 97-square-kilometer (37-square-mile) area centered on the Browns Ferry Nuclear Power Station located near Decatur, Alabama. The survey was conducted at a nominal altitude of 46 meters (150 feet) with line spacings of 76 meters (250 feet). A contour map of the terrestrial gamma exposure rate plus the cosmic exposure rate extrapolated to 1 meter above ground level was prepared and overlaid on an aerial photograph and a USGS topographic map of the area. The terrestrial exposure rates north and east of Wheeler Lake ranged from approximately 11 to 18 microroentgens per hour (μR/h), while the area south and west of the lake ranged from approximately 9 to 11 μR/h. Two areas of increased exposure rate were evident. One of these areas was associated with the main units of the reactor facility, while the other was associated with a temporary radiological waste holding area inside the plant's protected area. A machine-aided search of the data for man-made sources of radiation indicated the presence of a third area within the plant facility. This area is utilized as a temporary low-level radioactive waste storage site. All three areas indicated the presence of Co-60. Soil samples and ion chamber measurements were obtained at four locations to support the aerial data. In addition, soil samples were also taken at six locations along the shore of Wheeler Lake. 8 refs., 13 figs., 4 tabs.

12268 (EML—460, pp 1-154) **Characterization of radionuclides in North American and Hawaiian surface air and deposition following the Chernobyl accident.** Larsen, R.J.; Sanderson, C.G.; Rivera, W.; Zamichieli, M. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

Concentrations of gamma-ray emitting radionuclides in the surface air are presented for nine sites in North America and Hawaii following the Chernobyl accident. Activity ratios of these radionuclides have also been tabulated. The wet and dry deposition of ^{131}I, ^{134}Cs and ^{137}Cs are presented for four sites. The data suggest that a portion of the radionuclides that were released into the atmosphere following the explosion and fire at the Chernobyl-4 nuclear reactor were transported by the Northern Hemispheric polar front westerlies at altitudes up to several km. Sections of this cloud were randomly mixed with the surface air when the meteorological conditions for strong vertical mixing were favorable. From May 9 to May 10 enhanced vertical mixing within the contiguous US occurred, resulting in the sudden simultaneous appearance of particulate ^{131}I and ^{137}Cs in surface air. Elevated surface air concentrations of particulate ^{131}I and ^{137}Cs were generally associated with elevated ^{7}Be values. The mean activity ratio of $^{137}Cs/^{134}Cs$ (^{134}Cs has been decay corrected to April 26) for all sites was 1.9, with minor spatial and temporal variation. The amount of ^{131}I, ^{134}Cs and ^{137}Cs deposited and the mechanism for deposition varied with the rainfall patterns and the location and concentration of the radioactive debris in the atmosphere. Deposition velocities of ^{131}I, ^{134}Cs and ^{137}Cs are similar to those reported for sulfate. 8 references, 6 tables, 23 figures. 8 references, 23 figures 6 tables.

12269 (EML—460, pp 155-213) **Radiochemical characterization of Chernobyl fallout in Europe.** Krey, P.W.; Klusek, C.S.; Sanderson, C.; Miller, K.; Helfer, I. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

Radiochemical analyses of fallout in Europe from the Chernobyl reactor accident are reported by the Environmental Measurements Laboratory. Samples of soils, vegetation, air and precipitation were collected from global monitoring sites in Sweden, Monaco, Federal Republic of Germany, Denmark, Austria, and Italy. Samples were analyzed for zirconium-95, ruthenium-103, iodine-131, tellurium-132, cesium-134, barium-140 and cerium-141. Radionuclide ratios to cesium-134 are listed in tables. 6 references 1 figure, 50 tables.

12270 (EML—460, pp 224-243) **Observations and sampling by EML in Sweden, with preliminary gamma-ray spectrometric data.** Hardy, E.; Krey, P.; Klusek, C.; Miller, K.; Helfer, I.; Sanderson, C.; Rivera, W. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

Radiation measurements in air, soils and vegetation in Sweden following the Chernobyl reactor accident are reported. The data collected are presented as averages of the available radionuclide measurements made by gamma-ray spectrometry, expressed in units of aerial deposition decay-corrected to the sampling period. Data are included for concentrations of ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{131}I, ^{132}Te, ^{133}I, ^{134}Cs, ^{136}Cs, ^{137}Cs, ^{140}Ba, ^{140}La, and ^{141}Ce. 5 references, 1 figure, 13 tables.

12271 (EML—460, pp 284-290) **Measurements of the external radiation field in the New York metropolitan area.** Miller, K.M.; Geduldig, J. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

The specific purpose of the study described here was to measure any increase in the external radiation levels that occurred from the deposition of gamma-emitting isotopes associated with the Chernobyl nuclear power plant accident. The external exposure rate due to gamma emitters in the outdoor environment was monitored using continuous recording high pressure ionization chambers (HPIC). The monitors were located at their three stations that are routinely used for background studies: Chester NJ, EML's roof and Shoreham, NY. In addition, two extra units were placed in the field at Marlboro, NJ and Briarcliff Manor, NY shortly after the start of the accident for better geographical coverage. Gamma ray spectral measurements were carried out in situ using a 22% efficient Ge detector and portable 4000 channel pulse height analyzer. Data show that the total exposure rate from all Chernobyl fallout products in the New York area is estimated to have totaled < 0.1 μR/h (7 fA/kg) at its maximum. Since this fallout was spread out in time in the form of several precipitation events and episodes of dry deposition, it would not be discernible in the ion chamber data.

12272 (EML—460, pp 291-300) **Particle size distribution of Chernobyl related aerosols in New York City.** Knuth, R.H.; Sanderson, C.G. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

The Aerosol Studies Division of the Environmental Measurements Laboratory (EML) has been studying the size distribution and deposition characteristics of nonradioactive contaminants in the Northeast aerosol through the use of hi-volume impactors. On May 9th of 1986, a Sierra impactor was set up on the roof of EML in an attempt to sample the radioactive aerosols released during the accident at the Chernobyl power plant. From May 9-12 an integrated impactor sample was collected of the first detectable activity from the Chernobyl accident during the period of maximum concentration in the New York City area. The particle size distribution characteristics of the ^{131}I, ^{134}Cs and ^{137}Cs nuclides that were determined from this single impactor sample are presented.

12273 (EML—460, pp 301-307) **Concentrations of gaseous ^{131}I in New York City air following the Chernobyl accident.** Leifer, R.; Helfer, I.; Miller, K.; Silvestri, S. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

Gas samples were collected on the roof of the Environmental Measurements Laboratory (EML) from May 7 through June 12, 1986. Gamma spectroscopy indicated that many of their activated

charcoal air filters showed activity due to ^{131}I, which was related to emissions following the Chernobyl accident. Of the total gaseous ^{131}I activity measured during the May to June sampling period, almost 70% occurred during the first week of sampling. The total gaseous activity measured during May 7 through June 12 was 4.6 pCi.day/m^3 (170 mBq.day/m^3). The gaseous ^{131}I in air was 70% of the total ^{131}I measured over the entire period. Based on the limited amount of samples collected and tests conducted at EML the authors feel that the data presented in this paper, on the average, is accurate to within an error of +/- 30%.

12274 (EML—460, pp 327-331) **Study of the collection efficiency of gummed-film for fission products.** Beck, H.L.; Dreicer, M.; Helfer, I.K.; Geduldig, J. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

Samples of gummed-film were exposed daily during the period from early May to early June 1986 at two New York area sites. Both prior to and subsequent to this period, gummed film samples had been exposed at one of these sites as part of an ongoing study of the collection efficiency of gummed-film as a function of precipitation intensity for naturally occurring ^{7}Be. Data comparing the collection efficiency for Chernobyl fallout vs. ^{7}Be during rainfall at one of these two sites are presented here and are discussed in the context of these ongoing experiments with ^{7}Be.

12275 (UCRL—95481) **A transuranic aerosol measurement system: Preliminary results.** Prevo, C.T.; Kaifer, R.C.; Rueppel, D.W.; Delvasto, R.M.; Biermann, A.H.; Phelps, P.L. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 7p. (CONF-861007—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002389.

From Nuclear science and nuclear power systems symposium; Washington, DC, USA (29 Oct 1986).

We have completed the design, fabrication, and assembly of a computer-based prototype system for the measurement of transuranic aerosols in the workplace and environment. This system (called WOTAMS for Workplace Transuranic Aerosol Measurement System) incorporates two detectors: (1) an in-line solid-state alpha detector that sends out an alarm the moment a transuranic release occurs, and (2) an in-vacuum detector that increases off-line-analysis sensitivity. The in-line sensitivity of the system is better than 5.0 MPC-h, and the in-vacuum sensitivity exceeds 0.5 MPC-h. 5 refs., 8 figs., 1 tab.

12276 **Recovery of organic carbon from atmospheric particulate matter using soxhlet extraction with the benzene/methanol azeotrope.** Barkenbus, B.D.; Griest, W.H.; Huntzicker, J.J.; Heyerdahl, E.K.; MacDougall, C.S. (Oak Ridge National Lab., TN). *Journal of Environmental Science and Health, Part A: Environmental Science and Engineering;* **A18**: No. 2, 297-310(1983). Contract W-7405-ENG-26.

The extraction efficiency of the benzene/methanol azeotrope for organic carbon in atmospheric particulate matter was determined using a carbon types analyzer and also radio-labeled tracers and liquid scintillation spectroscopy. A twenty-four hour Soxhlet extraction with the azeotrope extracts 76 percent of the organic carbon, 15 percent of the elemental carbon, and 61 percent of the total carbon. Nonpolar and moderately polar organic compounds such as dotriacontane, benzo(a)pyrene, and stearic acid are extracted with 95 percent recovery. Highly polar oxygenated species such as succinic acid are extracted with an efficiency of 82 percent. The Soxhlet extractor was more efficient than ultrasonication for the extraction of highly polar species.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 10790, 12229, 12260

12277 **Global climatic trends as revealed by the recorded data.** Ellsaesser, H.W.; MacCracken, M.C.; Walton, J.J.; Grotch, S.L. (Atmospheric and Geophysical Sciences Division, Lawrence Livermore National Laboratory, Livermore, California). *Reviews of Geophysics and Space Physics;* **24**: No. 4, 745-792(Nov 1986).

Recent results from climate models have led to the prediction that a global warming due to increasing atmospheric CO_2 is now imminent, if it has not already occurred. In an effort to develop more definitive information on this question, a detailed review has been conducted of prior efforts to unravel climatic change from the various types of recorded observational data available. Most of the more definitive of the prior analyses: along with evaluative comments by the various authors: have been assembled herein. There appears little doubt that the average surface air temperature of at least northern hemisphere has been increasing since the beginning of recorded data with most of the warming occurring in a brief period circa 1920. The fragmentary early data suggest significant cooling prior to 1883 such that 25—50% of the subsequent warming may represent a return to earlier levels. Whether the overall warming constitutes a climate change remains an unresolved problem, as does the cause of the warming.

5005 Site Resource And Use Studies

12278 **(EUR—10570-IT) 27. meteorological yearbook 1985 of Ispra.** Bollini, G.; Galva, A.; Gandino, C.; Porrati, E. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 94p. (In Italian). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Scienze Fisiche.

The report contains daily and monthly values of climatic data measured in 1985 at the meteorological observatory of Ispra (Italy). In addition to data of air temperatures, humidity, wind and air pressure values of solar radiation are also presented. Numerous tables and diagrams contain statistics of the measured data.

5006 Regulations

REFER ALSO TO CITATION(S) 11438

12279 **(DOE/ER/60293—1) Chemistry of atmospheric precipitation at Lewes, Delaware, as part of the MAP3S study.** Church, T.M. (Delaware Univ., Newark (USA). Coll. of Marine Studies). 31 Jul 1986. Contract FG02-85ER60293. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002764.

The purpose of this proposal is to request continuation of funding for the routine operation and research activities at the MAP3S precipitation chemistry site at Lewes, Delaware (Site No. 7). Specifically, financial support is being requested to provide for (1) collection of precipitation samples on an event basis, (2) routine field analyses, processing and shipment of samples to Battelle Northwest Laboratories for further analyses, and (3) modest additional salary and laboratory costs to partially support centrally related research projects as described later.

12280 **(BG-Trans—07967) Preparatory study of project "oxides of nitrogen and the combustion of natural gas".** Locanetto, P. (British Gas Corp., London; Gaz de France, 75 - Paris). [1986]. Translation source information not available . 8p. NTIS, PC A02/MF A01. File Number DE87900428.

This study examined past methods for reducing NO/sub x/ for quantifying industrial emissions, for development of control regulations and their technical and economic implications. Industrial problems encountered in measuring emission, design modifications for lowering emission, and combustion process control were re-

viewed. Lastly, the practical part of compliance deals with the ready availability of pollution control equipment on the French market was considered. Equipment giving low NO/sub x/ emission must also reduce process costs and be adaptable to currently used equipment. (PSB)

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 12435

12281 **(CONF-870201—1) Effects of bark beetle outbreaks on species composition, biomass, and nutrient distribution in a mixed deciduous forest.** Johnson, D.W.; Henderson, G.S.; Harris, W.F. (Oak Ridge National Lab., TN (USA); Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife; National Science Foundation, Washington, DC (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86007237.

From Central hardwood forest conference; Knoxville, TN, USA (24 Feb 1987).

The increment of forest biomass and nutrient content on Walker Branch Watershed, Tennessee, from 1967 to 1983 was interrupted by two bark beetle outbreaks. An outbreak of the southern pine beetle in the early 1970s and an outbreak of the hickory borer in the late 1970s, early 1980s killed a number of shortleaf pine (Pinus echinata) and hickory (Carya spp.) respectively. Yellow-poplar (Liriodendron tulipifera) growth increased over this 16-year period, especially in response to the mortality of shortleaf pine. The net result of these events was little change in total biomass but a substantial shift in species composition (from pine to yellow-poplar) in the Pine forest type over this period. No species has yet responded to the mortality of hickory. Due to the shift in species composition in the Pine type, calcium and magnesium accumulation rates in biomass increased but foliage biomass decreased over the inventory period. There was little change in foliage biomass or nutrient content in other forest types. The beetle attacks, combined with apparently natural self-thinning, caused a large increase in standing dead biomass and in nutrient return via tree fall. This increased rate of return will substantially alter forest floor nutrient content and availability, especially with regard to calcium and nitrogen.

12282 **(INIS-BR—547) Salinization mechanisms in semi-arid regions. Study of the Pereira de Miranda and Caxitore dams, state of Ceara, Brazil.** Santiago, M.M.F. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1984. 189p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. File Number DE87700422.

During a period of three years the basins of the Pereira de Miranda and Caxitore dams, located in the crystalline rock area of Ceara, Brazil, were studied in order to determine the mechanisms of salinization of their waters. Isotope methods ($^{18}O/^{16}O$) and hidrochemistry (determination of the of the maior ions) were applied to surface, underground and rain water in this study. An isotope model was designed and applied to the determination of evaporation and percolation of dams in semi-arid zones during the dry season. The results are compared to those from a conventional chemical model. As causes of salinization of the water in the dams, the contributions of the rain itself and the lixiviation of the soil are quantified. An interaction between the dams and the underground water is imperceptible. The salinization of the underground water is attributed to recharge of the aquifer with rain water from the surface runoff followed by evaporation of the water rising, due to capilarity, in a one-directional flow to the surface.

12283 **(INIS-BR—548) Copper mineralization geology of Mandacaru, State of Piaui, Brazil.** Parente, C.V. (Brasilia Univ. (Brazil). Dept. de Geociencias). 1984. 213p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. File Number DE87700423.

It includes maps.

The Mandacaru area, Sao Juliao county, Piaui, comprises a Precambrian crystalline basement of granitic to quartaz dioritic gneisses overlain by several younger units of low grade metamorphics, volcanic and sedimentary rocks. The late Proterozoic Sao Juliao sequence comprises folded epicontinental marine metasediments of rank greenschist facies, including phyllite marble, metarkose and quartzite. The Eopaleozoic Catole Formation is represented by continental volcanic material (basalt, andesitic basalt, dacite, rhyolite, pyroclastics) and sedimentary rocks (conglomerate, arkosic wacke, felspathic sandstone, silt-stone), intruded by the post-tectonic Mandacaru Granite and related dykes and apophyses of granophyre, quartz porphyry, and other felsic subvolcanic roks. The intrusive rocks display subalkaline to slightly alkaline (potassic) trends. Rb-Sr isotope determinations yielded a reference isochron of 550+-8 my, Ri = 0,70924 +- 0,0010. Eopaleozoic volcanism, sedimentation and granite introsion are controlled by faulting and graben-like strucutures, the evolution of which culminated with the deposition of polymictic conglomerate and breccia of the Tamboril Formation. AII the previous units are unconformably overlain by the Silurian Serra Grande Formation at the eastern border of the Parnaiba Basin.

12284 **(INIS-BR—557) Ground Water movement in crystalline rock aquifers .** Serejo, A.N.C.; Freire, C.; Siqueira, H.B. de; Frischkorn, H.; Torquato, J.R.F.; Santiago, M.M.F.; Barbosa, P.C. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica). 1984. 67p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700424.

Ground water movement studies were performed in crystalline rock aquifers from the upper Acarau River hydrographic basin, state of Ceara, Brazil. The studies included carbon-14, $^{18}O/^{16}O$ and tritium measurements as well as chemical analysis. A total of 35 wells were surveyed during drought seasons. Carbon-14 values displayed little variation which implied that the water use was adequate despite of the slower recharge conditions. Fairly constant isotopic $^{18}O/^{16}O$ ratio values in the wells and their similarity with rainwater values indicated that the recharge is done exclusively by pluvial waters. A decreasing tendency within the tritium concentration values were interpreted as a periodic rainwater renewal for these aquifers. The chemical analysis demonstrated that there is in fact no correlation between salinity and the time the water remains in the aquifer itself. (D.J.M.).

12285 (INIS-BR—559, pp 257-262) **Use of ^{36}Cl diffusion to assess changes in pore geometry of allophane soils resulting from drying.** Holder, G.D. (University of the West Indies, St. Augustine, Trinidad). 1984. NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The apparent diffusion coefficient of ^{36}Cl is used to assess pore geometric changes in allophane soil resulting from drying. The diffusion method is based on the boundary condition of a planar source diffusing into an infinite medium. The extent of structural changes accompanying drying was indicated by changes in slope of a plot between geometric and interaction factors versus volumetric moisture content. Structural change was least for freeze drying to be followed by a larger but equal change for air and oven drying. (M.A.C.).

12286 (INIS-BR—559, pp 229-236) **Isotopically exchangeable phosphorus as a correction value to adsorption isotherms. Agriculturist applications.** Lopez, S.C.; Barbaro, N.O.; Rojas de Tramontini, S.L.; Martini, O. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Adsorption isotherms in evaluation and characterization of soils are studied. The quantity of phosphorus present at first in soil, evaluated by radioisotopic techniques and used in correction of Langmuir and Freundlich isotherms, is discussed.

12287 **(INIS-BR—566) Petrography, structure and geochemistry of nepheline syenites from the Pocos de Caldas alkaline massif, states of Minas Gerais and Sao Paulo, Brazil.** Ulbrich, H.H. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1984. 801p. (In Portuguese). NTIS (US Sales Only), PC A99/MF A01. File Number DE87700425.

The subcircular Mid-Cretaceous Pocos de Caldas alkaline massif, states of Minas Gerais and Sao Paulo, southern Brazil, covers over 800 Km^2, and has as its main rock types phonolites and nepheline syenites, with subordinate amounts of pyroclastic rocks. Nepheline syenites consist mainly of K-feldspar, nepheline and pyroxene, varying both in texture and 'rare-metal silicates' content. A useful petrographic division is that which classifies the rocks into agpaitic and non-agpaitic (miaskitic or intermediate) types. The latter varieties, characterized by the absence of rare-metal silicates, are predominant by far; agpaitic types are easily recognized by the presence of eudialyte and other rare-metal silicates. Both petrographic and, as far as possible, structural descriptions as well are given for most of the mapped nepheline syenite bodies; many bodies show subhorizontal or moderately-dipping contacts with their country rocks. Chemically, these rocks show, on the whole, high alkaline contents (12-15%) and commonly very high K_2O abundances. Chemical as well as additional isotopic and geochronological (Rb/Sr) data suggest that the asthenosphere is the source of parental magmas for the Pocos de Caldas nepheline syenites. The same arguments are used to reject, as unlikely, the magmatic activity interval (over 30 m.y.) given by previously published K/Ar ages. Simple structural models of the crust lithosphre in the Parana Basin area, coupled with the westward plate movement, suggest that irregularities at the asthenosphere-lithosphere decoupling surface are probable sites for melting of asthenospheric (and lithospheric) rocks induced by pressure relief. (D.J.M.).

12288 (INIS-BR—567, pp 100) **Use of ^{36}Cl diffusion to assess changes in pore geometry of allophane soils resulting from drying.** Holder, G.D. (University of the West Indies, St. Augustine, Trinidad). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12289 (INIS-BR—567, pp 83) **Fate of nitrogenous fertilizers in forest soil.** Pang, P.C.K. (Environment Canada, Pacific Forest Research Centre, Canada). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12290 **(INPE—3883) Nuclear geophysics in space and atmospheric research at INPE/BRAZIl.** Nordemann, D.J.R.; Pereira, E.B.; Marinho, E.V.A.; Sircilli Neto, F. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). May 1986. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700426.

During the last years, INPE's research in Nuclear Geophysics has developed in fields of interest to the Institute, the scientific community and the society in general. In the space research field it may be considered as a contribution to the history of meteorite falls in our planet or possible collision with big meteorites which may have been the cause of important effects such as biological extinction and extraterrestrial matter gathering. In the atmospheric research field, spatial and temporal variations of radon measurements in the lower atmosphere allow correlations from micrometeorology to worlwide scale through mesoscale, in the interpretation of phenomena which deal with the dynamics of air masses.

12291 **4.1. Response of the North American corn belt to climatic warming.** Blasing, T.J.; Solomon, A.M. (Oak Ridge National Lab., IL). *Progress in Biometeorology;* 3: 311-321(1984). Contract W-7405-ENG-26.

From C.E.C. symposium on interaction between climate and biosphere; Osnabrueck, Austria (21-23 Mar 1983).

The climate of the North American corn belt was characterized as part of an effort to estimate the effects of climatic change on that agricultural region. Heat and moisture characteristics of the current corn belt were first identified. Locations of those characteristics were then mapped, based on a climate simulated to result from doubling the amount of atmospheric CO_2. Such projections of corn-belt location were made both with and without allowance for earlier planting dates under a warmer climate. Because the direct effects of CO_2 on plants, improvements in farm technology, and plant breeding are not considered, the resulting projections represent an extreme or worst case. Results indicate that even for such a worst case, climatic conditions favoring corn production would not extend very far into Canada. Greatest translocations are projected for the western, or driest, part of the corn belt where other crops such as winter wheat could replace corn. However, this kind of exercise clearly shows that the use of climate-model output requires several highly questionable assumptions about changes in the timing and regional distribution of precipitation accompanying a climatic warming. Increased use of climatic data and improved specification of CO_2-induced increases in water-use efficiency of corn are suggested for more credible projections of corn belt responses to increasing CO_2. 12 references, 4 figures.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 10898, 10899, 11439, 12262, 12263, 12264, 12300, 12301, 12331

12292 **(BNL—52009) Yields of field-grown soybeans exposed to simulated acidic rainfalls.** Evans, L.S.; Lewin, K.F.; Hendrey, G.R. (Brookhaven National Lab., Upton, NY (USA). Terrestrial and Aquatic Ecology Div.). Jun 1986. Contract AC02-76CH00016. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003151.

Effects of simulated acidic rainfalls on seed yields of several cultivars of field grown soybean (Glycine max Merrill) were studied under automatically moveable rainfall exclusion shelters. In the five growing seasons (1981-1985) statistically significant effects of rain pH on yield occurred each year with the Amsoy 71 cultivar. In almost all bases, the seed yields from Amsoy plants treated with pH 5.6 rain were significantly greater than yields from plants receiving more acidic treatments. 1982 and 1983 experiments did not show any statistically significant reduction in seed yields of the Williams cultivar at acidity levels between pH 5.6 and pH 2.7. Altering the frequency and duration of the simulated rainfall did alter the yield of the Amsoy and Williams soybean cultivars, while treatment acidity did not. In 1984 and 1985, the Asgrow 3127, Corsoy 79, and Hobbit cultivars were studied along with Amsoy 71. The seed yields tended to be reduced when treated with rain simulants with acidity levels between pH 4.4 and pH 3.3, when compared to plants exposed to pH 5.6 rain simulant, but the observed reductions were not always statistically significant at the 95% confidence level. Studies examining the flowering and pod filling of soybean plants exposed to simulated acid rain were inconclusive for determining the cause of decrease in pod number per plant. (PSB)

12293 **(DOE/EV/10403—19) Resolution of source contributions to environmental samples: Final technical report.** Hopke, P.K. (Illinois Univ., Urbana (USA). Inst. for Environmental Studies). Dec 1986. Contract AC02-80EV10403. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87003775.

Mathematical methods were investigated for the resolution of source contributions to environmental samples. The focus has generally been on the contributions to airborne particulate matter levels by sources as determined through target transformation factor analysis and various regression methods using elemental composition data. Recent work has investigated analysis methods for individual particle data acquired by computer-controlled scanning electron microscopy.

12294 **(PB—87-110656/XAB) Mobile treatment technologies for superfund wastes.** (Versar, Inc., Springfield, VA (USA)). Sep 1986. 218p. NTIS, PC A10/MF A01.

The document addresses the use of established and developing mobile systems to treat Superfund wastes. The capabilities and limitations of five broad treatment categories, and specific technol-

ogies under each category, are discussed in the following chapters: Chapter 1 - Introduction; Chapter 2 - Thermal treatment; Chapter 3 - Immobilization; Chapter 4 - Chemical treatment; Chapter 5 - Physical treatment; Chapter 6 - Biological treatment.

12295 **(UCRL—95587) Leak tightness testing of underground tank systems.** Henry, R.K. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 23p. (CONF-860527—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003240.

From 41. annual Purdue industrial waste conference; West Lafayette, IN, USA (13 May 1986).

One hundred fifty underground tanks and sumps used to contain petroleum products and potentially contaminated process wastewater have given Lawrence Livermore National Laboratory an unusual opportunity to experiment with a variety of leak tightness test methods and compare applicability of each method. Five types of commercially available Precision Test leak-test equipment have been used: Associated Environmental Systems (AES), Hunter Leak Lokator, Horner Ezy-Check, Heath Petro-Tite, and Tank Auditor.

12296 **Phosphorus solubility in sludge-amended calcareous soils.** O'Connor, G.A.; Knudtsen, K.L.; Connell, G.A. (New Mexico State Univ., Las Cruces). *Journal of Environmental Quality;* **15**: No. 3, 308-312(Jul-Sep 1986). Contract AC04-83AL21776.

Sludge additions to calcareous soils in New Mexico increased water soluble and $NaHCO_3$-extractable P as well as plant uptake of P, whereas inorganic fertilizer P has often been ineffectual. This paper describes attempts to explain sludge effects in terms of increased solubility of secondary Ca-P solid phases (e.g., tricalcium and octacalcium phosphate) in amended calcareous soils. Both greenhouse and field data, representing several croppings of amended soils were examined. Ancillary effects, primarily slight pH reductions, associated with sludge additions to the soils were apparently responsible for increased P solubility in amended soils.

12297 **Hazardous waste on public lands.** Katz, S.L. (Dept. of Energy, Washington, DC). *Natural Resources and Environment;* **2**: No. 1, 13-17(Spr 1986).

Public land management has never before carried so serious a risk of loss to the treasury as the potential loss from the cost of remedying hazardous waste sites. Accordingly, BLM is faced with adopting new methods and procedures encompassing more active environmental enforcement. The hazardous waste laws will be considered in every phase of BLM activity. Land acquisitions and sales will be conducted with consideration for potential contamination of the property. Other activities, such as mining, mineral leasing, oil and gas operations and rights-of-way will be subject to more regulation and control than in the past. Still other uses, such as sanitary landfills, may ultimately be prohibited on public lands.

12298 **Hydrophobic sorption of polar organics by low organic carbon soils.** Southworth, G.R.; Keller, J.L. (Oak Ridge National Lab., TN). *Water, Air, and Soil Pollution;* **28**: No. 3-4, 239-248(1986).

The sorption of three groups of polar organic compounds capable of H bonding with inorganic soils surfaces (phenols, alcohols, and ketones) by three soils having different organic-carbon (OC) contents was compared with the sorption of nonpolar compounds by the same soils. Soil OC content and compound hydrophobicity were observed to be of value in predicting sorption coefficients for all groups of compounds except phenols. The higher OC soil (1.2% OC) exhibited a significant relationship between sorption coefficient and hydrophobicity for all compound classes; the very low OC soil (0.06% OC), however, exhibited a relative weak relationship between sorption coefficient and hydrophobicity. The data support the application of hydrophobicity-based predictions of soil/sediment sorption coefficients to compounds capable of weak H-bond interactions with mineral surfaces and soils of ≤ 0.1% OC.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 10979, 10980, 10981, 12269, 12270, 12314

12299 **(CONF-8609191—2) Comparative behavior of three long-lived radionuclides in forest ecosystems.** Auerbach, S.I. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001836.

From Seminar on the cycling of long-lived radionuclides in biosphere: observation and models; Madrid, Spain (15 Sep 1986).

This paper deals with studies in three forest ecosystems in eastern Tennessee, an area of rich temperate deciduous forests, sometimes referred to as mixed mesophytic forests. Two of these forest ecosystems were contaminated as a result of waste disposal operations. The third was experimentally tagged with millicurie quantities of ^{137}Cs. One of these ecosystems is a floodplain forest that is typical of this region. This forest has been growing on alluvial soils since 1944. Prior to that time the area was a temporary holding pond within White Oak Creek which received radioactive effluents from ORNL. Radiocesium was deposited in the pond sediments as were ^{90}Sr, ^{239}Pu, ^{241}Am, and other radionuclides. The dam which created the pond failed in late 1944, and the area was allowed to revert to natural conditions. The result was the development of a floodplain forest consisting of three different forest communities. The soils are fertile alluvials representative of bottomlands. The overstory tree species are principally ash, sycamore, boxelder, willow, and sweetgum (Fraxinus americana L., Plantanus occidentalis L., Acer negundo L., Salix nigra Marsh, and Liquidambar styraciflua L., respectively).

12300 **(CONF-8610144—Absts.) DOE-ORO contractors' environmental protection and waste management workshop: Program and abstracts.** Sekula, C.M. (ed.). (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001811.

From DOE/ORO contractors' environmental protection waste management workshop; Oak Ridge, TN, USA (28 Oct 1986).

Individual papers are processed separately for the data bases. (PSB)

12301 **(DP-MS—85-157) Ultra-clean underground counting facility for low-level environmental samples.** Winn, W.G.; Bowman, W.W.; Boni, A.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 49p. (CONF-8610174—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002657.

From 5. symposium on environmental radiochemical analysis; Harwell, UK (1 Oct 1986).

An underground counting facility with cleanroom environment has been designed and constructed to improve detection of low-level radioisotopes in the environment. The 3.0 m x 4.3 m x 2.4 m counting chamber is placed 14.3 m below ground, has 10.2-cm thick walls of pre-WWII naval armor plate, and is further shielded by a minimum of 1.2 m of specular hematite. The total overburden of shielding is equivalent to 31.7 m of water. Careful selection of building materials and a special air filtering system maintain a cleanroom environment with minimum contamination potential. Background improvements are noted relative to an earlier ground-level counting chamber with 30.5-cm-thick walls of pre-WWII naval armor plate. The gamma background continuum is reduced by a factor of 3 to 4 in the region of 0 to 10 MeV. A minimum of 10.2 cm of low-background lead around the detector optimizes this factor at 4 to 6. Discrete gammas from airborne natural radon daughters are eliminated by controlling the air near the detectors. Detectors constructed with low-level materials will further realize the improvements in background. A constant background is required for long counts of low-level samples, and the underground detectors are well shielded against surface operations. Performance appraisals of facility detectors include a large dual NaI(Tl) coincidence system, three smaller NaI(Tl) detectors, an HPGe well detector, and gas proportional and geiger counters. Major electronics for the detectors are located at a ground level control center to elimi-

nate any associated backgrounds. Because an individual sample may be counted several days, uninterruptable power is used. An IBM PC/XT computer processes spectra from multichannel analyzers using custom-developed software.

12302 (EML—460, pp 244-258) **Observations of Chernobyl fallout in Germany by in situ gamma-ray spectrometry.** Gogolak, C.V.; Winkelmann, I.; Weimer, S.; Wolff, S.; Klopfer, P. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

This report discusses some of the early results of measurements of Chernobyl fallout in Germany made by the Institute for Radiation Hygiene of the Federal Republic of Germany in collaboration with EML. Included are interpretations of in situ measurements near Munich, investigations of spatial and temporal variations in fallout depth distribution and development and testing of rapid field survey methods. Data are presented for the following nuclides: ^{141}Ce, ^{131}I, ^{103}Ru, ^{140}Ba, ^{137}Cs, ^{95}Nb, ^{134}Cs, ^{136}Cs and ^{140}La.

12303 (EML—460, pp 265-283) **Measurement of Chernobyl fallout activity in grass and soil at Chester, New Jersey.** Dreicer, M.; Helfer, I.K.; Miller, K.M. (Lawrence Livermore National Lab., CA). 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

In an attempt to gather more data on the interception and retention of ^{131}I in natural pasture grasses, the activity deposited from the contaminated air mass resulting from the Chernobyl accident in May and June of 1986 was measured on pasture grass in Chester, New Jersey. In some cases, the activity differed between the top and bottom strata of the grass, which indicates that it is important to take into account these differences when estimating the amount of ^{131}I consumed by the milk-producing cows. Rainfall appears to have some effect on the amount and distribution of the activity of the grass.

12304 (EML—460, pp 308-326) **Concentrations of ^{131}I, ^{134}Cs, and ^{137}Cs in milk in the New York metropolitan area following the Chernobyl reactor accident.** Klusek, C.S.; Sanderson, C.G.; Rivera, W. 1 Oct 1986. NTIS, PC A15/MF A01. File Number DE87001847.

In Compendium of the Environmental Measurements Laboratory's research projects related to the Chernobyl nuclear accident.

In the weeks following the Chernobyl accident fresh farm milk and pasteurized dairy milk were collected in the metropolitan New York area. Detectable levels of ^{131}I in fresh farm milk were first observed on May 12, ^{137}Cs on May 13 and ^{134}Cs on May 17. The highest concentrations measured in fresh farm milk were 40 pCi (1.47 Bq) ^{131}I/L; 18 pCi (0.66 Bq) ^{137}Cs/L; and 10 pCi (0.36 Bq) ^{134}Cs/L. The integrated activities were 360 pCi ^{131}I.day/L and 250 pCi ^{137}Cs.day/L in fresh farm milk. The results of the measurements in pasteurized dairy milk purchased in New York City reflect processing time, mixture of milk from a larger geographical area and various feeding regimes. Concentrations of ^{131}I in pasteurized dairy milk were similar to fresh farm milk. ^{137}Cs and ^{134}Cs concentrations were, however, only slightly above the detection limits during the entire sampling period.

12305 (INIS-BR—559, pp 217-227) **Isotopically exchangeable phosphorus. Critique revision.** Barbaro, N.O. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

A critique revision of isotope dilution is presented. The concepts and use of exchangeable phosphorus, the phosphate adsorption, the kinetics of isotopic exchange and the equilibrium time in soils are discussed.

12306 (NIRS-RSD—63, pp 19-20) **Strontium-90 and cesium-137 in vegetables (consuming districts) (from September 1982 to December 1982). Environmental and dietary materials.** Dec 1982. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780546.

In Radioactivity survey data in Japan.

Strontium-90 and cesium-137 in vegetables (consuming districts from September to December 1982) were determined. Spinach and Japanese radish were selected as the representatives for leaf vegetables and for non-starch roots, respectively, from seven sampling locations. The results are shown in a table.

12307 **(NTB—85-26) Modelling of solute transport in the near field of a high level waste repository.** Hopkirk, R.J.; Gilby, D.J.; Wagner, W.H. (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). May 1986. 125p. Nagra, Ch-5401 Baden, Switzerland.

The effects on solute transport of the bentonite backfill in the storage tunnel of an underground repository for highly active nuclear waste have been studied by means of mathematical models. The study concerns a hypothetical site, whose characteristics, however, with respect to geology, hydrology and geochemistry, have been derived from field observations. The models used to simulate migration processes are described, together with justifications for assumptions and with verification of methods. The results, presented as time histories of release fluxes up to at least one million years, demonstrate the delaying effect of the bentonite on both solubility-limited and highly soluble nuclides. The time required for the mass transport leads to the effective elimination of many nuclides with shorter half-lives before any significant release to the geosphere. Calculations have also been made to establish a conservative estimate of the rate of supply of corrosive sulphide ions to the metallic waste containers. Results and consequences of these computations are also discussed.

12308 **(NUREG—1227) Environmental assessment for renewal of Materials License No. SNM-778 (Docket no. 70-824).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Dec 1986. 88p. NTIS, PC A05/MF A01 - GPO. File Number TI87900406.

The Environmental Assessment includes discussions of the need for the proposed renewal action, alternatives to the action, and the environmental impacts of the proposed action. The staff has determined that the methods of waste confinement and effluent controls meet all applicable state and federal standards. The environmental impact of continued operation is insignificant.

12309 **(OEFZS—4372) Chernobyl reactor accident and its impact on Austrian agriculture.** Horak, O. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Landwirtschaft). Sep 1986. 16p. (In German). (LA—167/86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700439.

As a consequence of the Chernobyl reactor accident the environmental radioactivity in Austria increased far above the level recorded before. Radionuclides can enter into the foodchains by the contamination of agricultural products. Determining for the contamination is the behaviour of radionuclides in plants and soils, the development of vegetative plant mass at the moment of the accident and regional differences in fallout intensity. Contamination of plants is caused mainly by cesium-137 and cesium-134. Cs is taken up easily by plant foliage. Its mobility in the plant is high, even to fruits and seeds growing after the accident. Higher contaminations are recorded generally in winter cercals, rape, and fruits, while spring cercals, sugar beets and maize are nearly free from Cs-activity. Heavy contaminations with Cs appear in grassland vegetation as a result of combined uptake via leaves, plant base, and roots. The entry of caesium into the milk is one of the most serious consequences of the reactor accident. Transfer coefficients derived from prevailing experiments can be used for estimating the activity concentration in milk. Accordingly the threshold value of 5 nCi ^{137}Cs per liter milk should be reached when the daily intake by feeding is

about 700 nCi. During the grazing season the Cs-availability for cattle is distinctly lower.

12310 **Time-dependent leaching of radium from leaves and soil.** Simon, S.L.; Deming, E.J. (Colorado State Univ., Ft. Collins). *Journal of Environmental Quality;* **15**: No. 3, 305-308(Jul-Sep 1986). Contract AC02-79EV10305.

The accumulation of Ra or other radionuclides in vegetation via root uptake depends on the availability and uptake rate from soil, in addition to the rate of loss from the leaves due to natural leaching processes. Studies were conducted to determine the time-dependent leachable fraction of ^{226}Ra from soil as a function of time after soil spiking and the loss rate of internal ^{226}Ra from leaves due to leaching by exposure to natural field conditions. The leachable fraction of Ra from spiked soil decreased exponentially over time to a value of 0.1% after approximately 28 d. The internal Ra activity in leaves decreased exponentially to 40% of the original activity after 1 yr of exposure to outdoor conditions in a semiarid environment. The relationship of these two phenomena to the accumulation of Ra in plants via root uptake is illustrated by the equilibrium solution of a first-order differential equation.

12311 **Movements by small mammals on a radioactive waste disposal area in southeastern Idaho.** Groves, C.R.; Keller, B.L. (Idaho State Univ., Pocatello). *Great Basin Naturalist;* **46**: No. 3, 404-409(Jul 1986).

Average linear movement by populations of Dipodomys ordii, Microtus montanus, Perognathus parvus, and Peromyscus maniculatus was investigated over a 15-month period by live trapping on a low-level, radioactive waste disposal area in Idaho. No significant differences in movement among habitats were observed seasonally, excepting M. montanus in spring. Average linear movements within habitats ranged from 20 to 70 m for all species, but some patterns varied seasonally and among age classes for individual species. Although predation on contaminated small mammals from the disposal area is a vector of radionuclide transport, local movements by these rodents do not appear to be of sufficient magnitude to contribute significantly to redistribution of radioactive particles. 21 references, 2 figures, 3 tables.

12312 **Uranium and radium sorption on amorphous ferric oxyhydroxide.** Ames, L.L.; McGarrah, J.E.; Walker, B.A.; Salter, P.F. (Pacific Northwest Lab., Richland, WA). *Chemical Geology;* **40**: 135-148(1983). Contract AC06-76RL01830.

Sorption of uranium on amorphous ferric oxyhydroxide was investigated at 25° and 60°C from 0.01 M NaCl and 0.01 M $NaHCO_3$ solutions over an initial U concentration range of $\sim 10^{-4}$ to 5×10^{-7} M (23,800-93.2 ppB U). Uranium distributions coefficients ranged from more than 2×10^6 ml g^{-1} from 0.01 M NaCl at 25°C to $\sim 3 \times 10^4$ ml g^{-1} from 0.01 M $NaHCO_3$ at 25°C and fell rapidly with increasing initial U solution concentration. The uranium sorption data fit a Dubinin-Radushkevich sorption isotherm. Sorption of radium on amorphous ferric oxyhydroxide also was investigated at 25°C and 60°C from 0.01 M NaCl over an initial Ra concentration range of 5×10^{-7}-5×10^{-10} M (113-0.113 ppB Ra). The radium sorption data fit a Freundlich sorption isotherm with radium distribution coefficients ranging from a low of $\sim$1100 ml g^{-1} at 60°C to a high of $>$20,000 ml g^{-1} at 25°C, much lower than comparable uranium distribution coefficients. 20 references, 6 figures, 6 tables.

5105 Site Resource And Use Studies

12313 **(BDX—613-3641) Waste management operations, Bendix Kansas City Plant.** Gentry, K. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Nov 1986. Contract AC04-76DP00613. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002951.

The plant manufactures non-nuclear components for nuclear weapons and, as such, is essentially a series of job shops. A multitude of generating departments generate waste streams that include plating waste, solvents, lubricating fluids, heat transfer fluids, waste cleaning materials, potting compounds, and lead/acid batteries, among others. In 1980, with the upcoming RwateRA regulations, Bendix created a separate department to consolidate all waste and scrap operations. The Waste Mangement Department incorporated the handling of all material leaving the plant except product. This included hazardous waste, plant refuse, returnable containers, excess equipment, recyclable scrap, recoverable precious metals, and many other items. The department was charged with all activities related to RCRA. In order to accomplish this, a new job classification, Material Handler, was created with the flexibility to cross traditional lines between other labor calssifications. Other plans are given.

12314 **(CONF-870405—11) Shielding calculations at dismantled synchrocyclotron.** Yalcintas, M.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000232.

From Radiation protection and shielding conference; Knoxville, TN, USA (22 Apr 1987).

The Space Radiation Effects Laboratory (SREL) located in Newport News, Virginia, was operated by the College of William and Mary for the National Aeronautics and Space Administration (NASA). A synchrocyclotron was formerly in operation in this building and a primary beam of 600 MeV protons and secondary beams of 400 MeV pions and muons were produced for the purpose of studying the effects of radiation on materials, components, and systems planned for use in space. The synchrocyclotron and its accessory equipment were removed in 1980. At several locations, the scattered synchrocyclotron beam caused an induced radioactivity within the walls of the cyclotron room. The concrete shields surrounding the synchrocyclotron have been removed from the building and stored adjacent to the radiochemistry laboratory. The facility is no longer operational; it has been decided to decommission the synchrocyclotron. In 1985, the Oak Ridge National Laboratory Radiological Survey Activities (ORNL/RASA) group was invited to perform a radiological survey to determine the amount of residual radioactivity on the walls and the floor, calculate the dose to potential occupants working in the building, and make recommendations to minimize exposures from the residual radioactivity on the walls and the floor of the cyclotron room. In this paper, accelerator decommissioning is reviewed, and criteria for decommissioning of accelerators is discussed. The survey method is described, and the findings at the SREL are presented.

12315 **(DOE/BP/60445—1) Wildlife protection, mitigation and enhancement planning for Grand Coulee Dam: Final report.** Creveling, J.; Renfrow, B. (Washington State Dept. of Game, Olympia (USA). Habitat Management Div.). 1986. Contract AI79-86BP60445. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87003084.

The development and operation of Grand Coulee Dam inundated approximately 70,000 acres of wildlife habitat under the jurisdictions of the Colville Confederated Tribes, the Spokane Tribe, and the State of Washington. Under the provisions of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, this study reviews losses to wildlife and habitat, and proposes mitigation for those losses. Wildlife loss estimates were developed from information available in the literature. Habitat losses and potential habitat gains through mitigation were estimated by a modified Habitat Evaluation Procedure. The mitigation plan proposes (1) acquisition of sufficient land or management rights to land to protect Habitat Units equivalent to those lost (approximately 73,000 acres of land would be required), (2) improvement and management of those lands to obtain and perpetuate target Habitat Units, and (3) protection and enhancement of suitable habitat for bald eagles. Mitigation is presented as four actions to be implemented over a 10-year period. A monitoring program is proposed to monitor mitigation success in terms of Habitat Units and wildlife population trends.

12316 **(DOE/NV/10384—04) Effects of surface collapse structures on infiltration and moisture redistribution.** Tyler, S.W.; McKay, W.A.; Hess, J.W.; Jacobson, R.L.; Taylor, K. (Nevada Univ., Reno (USA). Water Resources Center). Mar 1986. Contract AC08-85NV10384. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87002163.

Two boreholes were completed in and adjacent to subsidence crater U3fd on the Department of Energy's (DOE) Nevada Test Site. The holes were respectively 46.4 and 30.7 meters deep and were to determine the effects of subsidence structures on subsurface moisture migration. Analysis of core and borehole geophysical tests indicates that the average volumetric water content of the soil profile to a depth of 29.8 meters below the crater bottom was 100% greater than that of soils in the adjacent undisturbed area. Hydraulic conductivity and hydraulic gradient values from core samples indicate that a downward water flux (expressed as a volume per unit area per time) of between 0.54 and 4.22 meters per year is occurring directly below the crater bottom. Downward flux conditions were observed throughout the entire 46.4 m profile drilled below the crater. Core data from the undisturbed environment indicates that immeasureable, if any, downward flux, or recharge, is occurring in this area. Surface resistivity data taken at both areas show considerably lower soil resistance in the disturbed area, however, other environmental factors (buried metal objects, soil compaction, and salt leaching) limit its use in determining quantity and extent of infiltrated water.

12317 **(ORNL/ESH—1/V22) Resource Management Plan for the Oak Ridge Reservation: Volume 22, Resource information and site analysis for planning on the Oak Ridge Reservation.** Chance, W.W. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 227p. NTIS, PC A11/MF A01. File Number DE87004033.

The Department of Energy's (DOE's) Oak Ridge Reservation (ORR) consists of approximately 15,000 ha (37,000 acres) of federally owned lands; it contains three major facilities (Oak Ridge Gaseous Diffusion Plant, Oak Ridge National Laboratory, and the Oak Ridge Y-12 Plant) operated by a single contractor and a number of other facilities operated either by DOE or under contract to others. This report documents the various land use elements, land use constraints (physical, programmatic, and geopolitical), and site potential capabilities and provides current documentation of related data for making land use and site development decisions. The ORR has physical, programmatic, and geopolitical constraints that have been identified, measured, and mapped. The constraints and opportunities map was used to identify developable land areas. Many of these sites have only remote potential for meeting any planned needs for expansion of existing facilities. However, stand-alone research functions or other facilities are possible on these sites. These studied and measured findings lead to the conclusion that extreme care must be taken in the evaluation of future use or disposition of available land. Furthermore, it is time to consider and evaluate the feasibility for renewal. The potential for recycling lands formerly used by programs and functions that have been completed or terminated is very real, considering the age, condition, and obsolescence of these facilities.

5106 Regulations

REFER ALSO TO CITATION(S) 12308

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 11020

12318 **(DOE/BP/18186—1) Etiology of early lifestage diseases, Project 84-44: Final report.** (Oregon Univ., Portland (USA). Health Sciences Center). Oct 1986. Contract AC79-84BP18186. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87002985.

Each year hatcheries experience loss of eggs, fry and fingerlings due to a group of poorly defined diseases called White Spot and Coagulated Yolk. Samples of maternal blood and ovarian fluid (coelomic fluid), as well as unfertilized eggs, were collected at spawning and subsequently tested for the presence of bacteria. Our tests reveal that there is a wide range in mortality rates experienced by the progeny of different brood salmon. Microbiologic tests revealed that these eggs contained a variety of both Gram positive and Gram negative bacteria within their yolk and that the fluids from the females who produced these lots were contaminated with a variety of bacteria. In contrast the eggs and maternal fluids from the six egg lots which experienced the lowest mortalities did not contain high numbers of Gram positive bacteria and contributed only 5% of the total mortalities observed within the 30 egg lots tested. From the 60 egg lots tested over two brood years we have isolated 18 different bacterial genera containing 32 different species from within the yolk surface sterilized, unfertilized eggs. Our tests suggest that Aeromonas hydrophila, Pseudomonas (3 species) Staphylococcus aureus, Vibrio sp., Corynebacterium hoffmanii, Listeria sp. and Bacillus sp. when detected within the yolk of eggs sampled from egg lots prior to fertilization will be associated with higher than normal mortality rates when the remainder of the egg lots containing these bacteria are incubated and reared. 36 refs., 16 figs.

12319 **(DOE/ER/60353—2) Biological processes in the water column of the south Atlantic bight: Phytoplankton responses: Progress report, June 1986 to May 1987.** Yoder, J.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 3 Dec 1986. Contract FG09-85ER60353. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003987.

Research progress is reported in the following areas: (1) BIOTRANS - phytoplankton studies; (2) microzooplankton studies; and (3) analysis of CZCS imagery. (ACR)

12320 **(NUCLEBRAS-CDTN—549) Tracers in measurement and analysis of river pollution.** Moreira, R.M.; Castro, J.O.N.M. de. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700437.

Pollutant matter discharged into streams undergo a process of dispersion caused by turbulence and shear dispersion. A physical dilution ensues, to which in some cases is added the decay of the pollutant. Hence, a natural process of self purification results and this characteristic of the stream has a most important ecological and economical meaning. Its evaluation allows the optimization of effluent treatment works, at the same time ensuring the compliance with established water quality criteria. The use of tracres, together with the calibration of mathematical models and with the information they afford, make possible the impact assessment and the adaptive control of the effects of pollutant disposal into streams. This paper classifies the models apropriate for each discharge type, discusses the calibration methods and presents an application of these techniques to a real situation of a medium size river.

12321 **(PB—87-107546/XAB) Outer Continental Shelf environmental assesment program. Final reports of principal investigators. volume 37.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Mar 1986. 667p. NTIS, PC A99/MF A01.

A compilation of seven final reports dealing with seal/sea lion and walrus surveys of the Navarin Basin; potential impacts of man-made noise on ringed seals; modern populations, migrations, demography, trophics, and historical status of the Pacific Walrus; distribution of marine mammals in the coastal zone of the eastern Chukchi Sea during summer and autumn; and early spring distribution, density and abundance of the Pacific Walrus in 1976.

12322 **(TR-EL—82-4/82-11-62) Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): Steelhead trout.** Pauley, G.B.; Bortz, B.M.; Shepard, M.F. (Washington Univ., Seattle (USA). Coll. of Ocean and Fishery Sciences). Aug 1986. 32p. NTIS, PC A03/MF A01. File Number TI87900131.

The steelhead is an anadromous form of the rainbow trout Salmo gairdneri found from central California to Alaska. The commercial fishery in the Pacific Northwest is restricted to specific Indian tribes. Washington and Oregon support an important recreational fishery. In Washington and Oregon, two runs of steelhead exist. Winter-run steelhead enter their native streams in late fall and

winter, and usually spawn by the following May. Summer-run steelhead return to their home streams in spring and summer, and usually spawn in the following spring. California stocks apparently consist only of winter-run fish. Female steelhead bury their eggs in gravel in streams after spawning. Proper temperature and dissolved oxygen levels are necessary for incubation of eggs and rearing in streams. Adequate particle size of stream gravel and adequate stream velocity are essential for incubation.

12323 **Mass transfer to an from small particles in the sea.** Csanady, G.T. (Woods Hole Oceanographic Institution, MA). *Limnology and Oceanography;* **31**: No. 2, 237-248(Mar 1986). Contract AC02-79EV10005.

Slowly sinking particles exchange mass with their liquid environment if dissolution processes within the particles maintain a surface concentration excess or deficiency x_0 of a soluble substance above background. If the exchange is controlled by diffusion in the liquid phase, the total mass loss is proportional to x_0, diffusivity D, and particle diameter d. If advection associated with the sinking of the particle dominates over diffusion, the exchange rate varies as $x_0D/sup\ 2/3/d^3$ and is weakly affected by particle density and fluid viscosity. This is the case for spherical particles of a diameter ? 70 μm. The resulting dissolution rate per unit depth of sinking is constant for large particles, but increases sharply once the particles are small and slow enough for mass exchange to be controlled by diffusion. With oxygen supply supposed the rate-controlling process of particle decomposition, a realistic depth of decomposition of order 1 km is calculated for 200-μm-diameter spherical particles. The generation of an oxygen minimum at such depths then requires the production near the sea surface of sufficiently large organic particles in sufficient numbers.

12324 **Relevance of scavenging kinetics to modeling of sediment-water interactions in natural waters.** Nyffeler, U.P.; Santschi, P.H.; Li, Y.H. (Lamont-Doherty Geological Observatory of Columbia Univ., Palisades, NY). *Limnology and Oceanography;* **31**: No. 2, 277-292(Mar 1986).

The uptake of radioactive trace metals by suspended particles in natural aquatic systems is often slow and the time constants for scavenging are of the same order of magnitude as the residence times of particles in the water column. Therefore, models simulating removal of radioactive trace metals from water to sediments in shallow aquatic systems with short particle residence times need to include sorption (i.e. scavenging) kinetics. The authors present a numerical kinetic transport model designed to simulate tracer movements from a well mixed water column where particles are generated by both primary production and sediment resuspension processes. Tracers are allowed to penetrate into underlying sediments by diffusion and particle and pore water mixing. All model parameters can be experimentally determined either in the ecosystem itself or in separate laboratory experiments. Limited sensitivity analyses and simulations of actual experiments indicate that under conditions of particle cycling in the sediments and the water, tracer removal can be affected and even be limited by the slow kinetics of tracer uptake by suspended particles. The model is also useful in identifying and quantifying critical pathways in the complicated web of interrelated processes of an aquatic ecosystem.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 10873, 10898, 11439, 11802, 12262, 12263, 12264, 12333

12325 **(EPRI-EA—4906) Paleoecological investigation of recent lake acidification: Methods and project description: Interim report.** Charles, D.F.; Whitehead, D.R. (eds.). (Indiana Univ., Bloomington (USA). Dept. of Biology). Nov 1986. 209p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920113.

This report documents the methods used for the interdisciplinary paleoecological investigation of five to fifteen comparable watershed/lake systems from each of four low-alkalinity regions that are currently receiving acidic deposition: Adriondack Mountains, NY, northern New England, northern Great Lakes states, and northern Florida. The primary objective of the study is to develop an integrated paleoecological approach to making a detailed reconstruction of the recent history of pH-related changes and demonstrating this approach in a representative suite of lakes from each of the regions. Inference of historical pH levels is based on diatom stratigraphies with chrysophytes used for support. Dating of sediments strata is based on lead-210 with pollen and charcoal used for support. Other sediment stratigraphies are measured either to explore possible causes of any inferred pH changes or to test their ability to reflect the pH changes indicated by the diatoms and chrysophytes. The major portion of the report is detailed descriptions of methods used for PIRLA research activities: lake selection; watershed and climatic history analysis, sediment coring and subsampling; analysis of sediment pollen and charcoal, coal and oil soot, diatoms, chrysophytes, chironomids, cladocera, Pb-210 dating, total metals, sequential extraction of metals, polycyclic aromatic hydrocarbons, total sulfur, carbon, nitrogen and hydrogen, sulfur isotopes; water chemistry; and the variability study.

12326 **(SGU—44) Ground water quality.** Engqvist, P.; Fagerlind, T.; Lundstroem, A.; Sandstroem, S. (Sveriges Geologiska Undersoekning, Uppsala). 1985. 118p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87750623.

Approximately 5,200 groundwater analyses from all over the country have been collected and treated in different ways in a computor. The measured properties are colour, suspended matter, odour, turbidity, spec. conductivity, pH, HC0/sub 3/, CO/sub 2/, C1, SO/sub 4/, total hardness, KMnO/sub 4/, NH/sub 4/, NO/sub 2/, NO/sub 3/, F, PO/sub 4/, Fe,Mn. The country has been subdivided into six regions, within which the samples have been grouped according to the character of the aquifer. The latter has been treated in three categories - Quaternary deposits, Precambrium rocks and younger sedimentary rocks. The different parameters have been evaluated statistically with regard to min, max, median, mean and upper and lower quartiles. Frequency diagrams have also been constructed for each sub-group of the ground water sample population. The above- mentioned ground water properties together with information on welldepth and thickness of the overburden have provided the data base for the statistical analyses. Dependent on the range, mean and median values of the different properties, the primary data have been grouped in specific intervals and correlated with the above-mentioned parameters.

12327 **(TVA/ONRED/AWR—86/57) PCB [polychlorinated biphenyls] concentrations in Wilson Reservoir catfish, 1985.** Dycus, D.L.; Lowery, D.R. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Sep 1986. 44p. NTIS, PC A03/MF A01. File Number DE87900332.

TVA conducted a study during autumn 1984 to determine concentrations of a variety of contaminants in biota from Wilson and upper Pickwick Reservoirs. Several contaminants were detected, with polychlorinated biphenyls (PCB) levels in catfish from Wilson Reservoir of greatest interest. PCB concentrations in twenty-two of 45 catfish from Wilson equaled or exceeded the Food and Drug Administration (FDA) tolerance of 2.0 μg/g and the average of all 45 was 2.6 μg/g. Contamination was widespread and did not show any geographical relationship to an embayment on Wilson Reservoir (Fleet Hollow) known to have PCBs in the sediments. As a result of these findings, the Northwest Alabama Regional Health Department issued an official notice to retail markets in June 1985 to discontinue selling catfish from Wilson Reservoir. TVA initiated studies to determine if there were other areas on Wilson with PCB contaminated sediments or PCB discharges, and an annual catfish collection was started in autumn 1985 to determine the year-to-year trend in PCB levels. As a follow-up to earlier studies, analyses of catfish collected during autumn 1985 indicated substantial reductions in PCB concentrations. Only 4 of 36 catfish had PCB concentrations which equaled or exceeded 2.0 μg/g and the overall average was 1.0 μg/g. Statistical analyses indicated PCB concentrations decreased with increased distance from Fleet Hollow. Further monitoring is recommended for 2 more years.

12328 **(UCRL—15835-Vol.1) Ground water investigation at Lawrence Livermore National Laboratory, Livermore, California: Volume one, Text: Annual report for fiscal year 1985.** (Weiss Associates, Berkeley, CA (USA); Lawrence Livermore National Lab., CA (USA)). Dec 1985. Contract W-7405-ENG-48. 417p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE87003891.

Data was compiled regarding past and present uses, storage and disposal of hazardous materials at Lawrence Livermore National Laboratory (LLNL), Livermore, California and antecedent site activities. Thirty-two monitor wells were installed at and near LLNL to: (1) provide baseline hydrogeologic data, (2) begin defining the vertical and lateral extent of VOCs in ground water at and west of LLNL and (3) evaluate potential sources of VOCs in ground water at LLNL. Ground water samples were collected and analyzed for VOCs from all new and previously installed LLNL monitor wells and selected private and Alameda County Flood Control and Water Conservation District, Zone 7 wells. Aquifer tests were performed in selected wells to: (1) evaluate vertical hydraulic communication between adjacent shallow and deeper wells, (2) estimate the transmissivity and hydraulic conductivity of water-bearing sediments, (3) estimate ground water flow rates, and (4) assess well efficiency. A technique was developed to collect uncontaminated saturated soil samples from several water-bearing zones in a single borehole. Five wells and four borings were also drilled in the Building 403 area to investigate the presence of fuel hydrocarbons in soil and ground water.

12329 **(UCRL—15835-Vol.2) Ground water investigation at Lawrence Livermore National Laboratory, Livermore, California: Volume two, Appendixes: Annual report for fiscal year 1985.** (Weiss Associates, Berkeley, CA (USA); Lawrence Livermore National Lab., CA (USA)). Dec 1985. Contract W-7405-ENG-48. 370p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87003892.

This volume contains the following appendices: (1) California state well numbering system; (2) well logs; (3) ground water sampling protocol; (4) water level data; (5) well destruction details, wells 11R3, 11R4, and 11R81; (6) aquifer test procedures; (7) results of VOC analyses of saturated soil; (8) results of VOC analyses of ground water; and (9) action levels recommended by DOHS. (ACR)

12330 **(UCRL—15854) Testing and sampling of existing wells in the vicinity of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore, California: Final report.** (Hydro Geo Chem., Inc., Tucson, AZ (USA); Lawrence Livermore National Lab., CA (USA)). 10 Jun 1984. Contract W-7405-ENG-48. 94p. NTIS, PC A05. File Number DE87003883.

Hydraulic testing and sampling of seven existing water wells was performed in the vicinity of Lawrence Livermore National Laboratory and Sandia National Laboratories. These tests were performed in support of an ongoing investigation of trichloroethylene (TCE) and perchloroethylene (PCE) groundwater contamination. Much of the hydraulic testing and sampling was performed using a straddle packer/submersible pump assembly which allowed isolating and pumping discrete producing zones in multiply completed wells. This testing procedure was specially designed for this investigation to define the vertical distribution of contaminants.

12331 **(UCRL—15856) Remedial action plan for gasoline leak near Building 403, Lawrence Livermore National Laboratory, Livermore, California.** (Lawrence Livermore National Lab., CA (USA); O.H. Materials Co., Findlay, OH (USA)). 21 Oct 1985. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003885.

Remedial requirements and alternatives associated with the leakage of gasoline in the vicinity of Building 403 at the Lawrence Livermore National Laboratory (LLNL) in Livermore, California were evaluated. Subsurface investigations included drilling borings, sampling soils, installing observation wells, sampling ground water from the newly installed and existing wells, chemically analyzing the soil and water samples, performing slug tests, and conducting a surface geophysical and a biodegradation laboratory study. At the same time, LLNL subcontractors conducted geophysical logging of the boreholes. The objectives were to summarize the site conditions, present the logic by which remedial alternatives were evaluated, and present a conceptual plan for remedial action. The conceptual action plan presents three alternative levels of cleanup: a virtually complete removal of contaminants, a intermediate approach intended to remove most of the contaminants, and a no-action/minimal action approach.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 10964, 10965, 10966, 10967, 10968, 10969, 10970, 10971, 10972, 10973, 10974, 10975, 10976, 10977, 10978, 10981, 11899, 12300

12332 **(CONF-870219—2) An analysis of groundwater contamination from the operation of a 6-GeV continuous electron beam accelerator.** Lee, D.W. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002413.

From Midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

The potential contamination groundwater in the vicinity of a beam dump associated with a 6-GeV continuous electron beam accelerator has been analyzed considering the site hydrology. The potential contamination arising from photoneutron activation of soil and the subsequent leaching, transport, and decay of tritium are examined. The analysis accounts for dilution from groundwater transport and infiltration of precipitation. The results demonstrate that dilution reduces the concentration of tritium in the groundwter by one order of magnitude from a simple production and transport model that does not consider the effects of dilution. 5 refs., 2 figs., 2 tabs.

12333 **(DOE/CH/10255—1) An investigation of trace metals in the aqueous environment: Progress report for the period January 1986 through December 1986.** Wilson, B.L. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 1986. Contract FG02-86CH10255. 17p. NTIS, PC A02. File Number DE87003418.

The main objectives of this project are the following: to investigate the following trace metals which are found in the aqueous environment: Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Ti, V, and Zn; and to study the natural radionuclides: ^{40}K, ^{210}Pb, ^{228}Th, ^{228}Ra, ^{235}U, and ^{238}U which may be released in the fly ash of coal fired power plants or as nuclear weapon waste products.

12334 **(INIS-BR—558) Previous research of the Zooplankton in the area of influence of Nuclear Central Almirante Alvaro Alberto, in Angra dos Reis (Piraquara de Fora Bay) - RJ/Brazil.** Victal, J.L.V.; Bjornberg, T.K.S. (Instituto Nacional de Estudos do Mar, Arraial do Cabo (Brazil); FURNAS, Rio de Janeiro (Brazil)). 1984. 1p. (In Portuguese). (CONF-8412118—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700440.

From 1. plancton Brazilian meeting; Arraial do Cabo, Brazil (3 Dec 1984).

Published in summary form only.

12335 (NIRS-RSD—63, pp 22-24) **Strontium-90 and cesium-137 in sea fish (from June 1982 to December 1982). Environmental and dietary materials.** Dec 1982. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780546.

In Radioactivity survey data in Japan.

Strontium-90 and cesium-137 in sea fish (from June to December 1982) were determined. Fish was collected from 22 sampling locations. Only the edible part was used in case of larger sized fish, and the whole part was used in case of smaller ones. The results are shown in a table.

5204 Thermal Effluents Monitoring And Transport

12336 (DP—1730) Chlorination/dechlorination studies relating to proposed cooling towers for K and C reactors. Wilde, E.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1986. Contract AC09-76SR00001. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003779.

The purpose of this study was to obtain data on the chlorination and dechlorination of the cooling water that is pumped through the C- and K-Reactor heat exchangers. More specifically, data were obtained on: (1) chlorine demand and dissipation rates; (2) the effectiveness of sodium sulfite as a dechlorinating agent; (3) the toxicity of chlorination and dechlorination on indigenous fish; (4) the effects of dechlorination on water quality; and (5) the comparative precision of three conventional residual chlorine detection methods. The study results strongly indicate that implementation of present plans for chlorination and dechlorination (with sodium sulfite) of SRP reactor cooling towers will cause no significant adverse environmental impacts and should not result in problems in meeting future regulatory guidelines for TRC. 9 figs., 11 tabs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 12313, 12328, 12329, 12343

12337 (DOE/BP/61748—1) Juvenile salmonid monitoring at Rock Island Dam bypass sampler: Annual report. Fielder, P.C.; Peven, C.M. (Public Utility District No. 1 of Chelan County, Wenatchee, WA (USA)). Oct 1986. Contract AI79-86BP61748. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003080.

Downstream migrating salmon (Oncorhynchus spp.) and steelhead (Salmo gairdneri) smolts were monitored at the Rock Island Dam bypass trap from 1 April - 31 August, 1986. Data collected included: (1) number of fish caught per species; (2) number of branded fish caught per species; (3) daily average riverflow; (4) daily average powerhouse No. 1 and No. 2 flows; and (5) daily average spill. These data were transmitted to, and used by, the Fish Passage Center to manage a "water budget" of allocated upstream water storage to augment river flows to improve survival of downstream migrating salmonids. The Rock Island Dam trapping facility collected 176,188 downstream migrating salmonids in 1986. Collected fish included 901 chinook salmon (Oncorhynchus tshawytscha) and 1502 steelhead which had been freeze branded (to determine migration and survival rates) and 2290 chinook and 22,506 steelhead with clipped adipose fins. The middle 80% (between 10% and 90%) of the 1986 spring migration (excluding sub-yearling chinooks) passed Rock Island Dam during a 32 day period, 29 April - 30 May. Passage rates of hatchery released chinook and steelhead smolts and downstream migration timing of all salmonids are presented.

12338 (LA—10835-PR) Water supply at Los Alamos during 1985: Progress report. Purtymun, W.D.; Becker, N.M.; Maes, M.N. (Los Alamos National Lab., NM (USA)). Oct 1986. Contract W-7405-ENG-36. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003800.

Well field operations during 1985 were satisfactory with municipal and industrial supplies consisting of 1587 x 10^6 gal from wells in three well fields and 37 x 10^6 gal from the gallery in Water Canyon. About 2.8 x 10^6 gal of water from Guaje Reservoir and 0.9 x 10^6 gal from Los Alamos Reservoir were used for irrigation; thus the total water usage in 1985 was about 1628 x 10^6 gal. Primary and secondary chemical quality of water in the distribution system is in compliance with federal regulations.

12339 (ORNL/ESH—1/V21) Resource Management Plan for the Oak Ridge Reservation: Volume 21, Water Conservation Plan for the Oak Ridge Reservation. Kasten, J.L. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01. File Number DE87004049.

This Water Conservation Plan covers facilities within the ORR including the Y-12 Plant, Oak Ridge National Laboratory (ORNL), Oak Ridge Gaseous Diffusion Plant (ORGDP), the Industrial Park, the Scarboro Facility, Rust Engineering, and the Clark Center Recreation Area. The water balance for the ORR is summarized and plans for optimizing water usage and protecting water quality are included. Temporary measures to curtail water usage in the event of a drought are also summarized.

12340 (TVA/ONRED/AWR—86/58) Fishery status assessment of Tims Ford Reservoir with management recommendations. Lowery, D.R.; Taylor, F.H. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Apr 1986. 53p. NTIS, PC A04/MF A01. File Number DE87900333.

Fishery information was collected on Tims Ford Reservoir to determine the status of the fishery resource as an indictor of the biological health of these reservoirs, and to formulate management recommendations for improving the status of the biological resource that can be implemented by TVA and/or cooperating agencies.

12341 (TVA/PUB—87/5) John Sevier Aquatic Biological Program: Paddlefish stocking and assessment report for 1986. Pasch, R.W. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Jun 1986. 6p. NTIS, PC A02/MF A01. File Number DE87900330.

In January, 1986, approximately 10,700 yearling paddlefish were released in Cherokee Reservoir. Initial mortality was apparently low, with fewer than 100 stocked paddlefish found dead in the vicinity of the release site. Subsequent sampling has yielded little data on distribution and abundance of paddlefish in Cherokee Reservoir. Observations suggest young paddlefish dispersed widely and may not have experienced heavy mortality. (ACR)

12342 (TVA/PUB—87/6) The biological effects of bank stabilization structures on fish and benthic macroinvertebrates in Fort Loudoun Lake: Final report. Hylton, R.E.; Spencer, M.D.; Bettoli, P.W. (ed.). (Tennessee Technological Univ., Cookeville (USA). Tennessee Cooperative Fishery Research Unit). Jul 1986. 167p. NTIS, PC A08/MF A01. File Number DE87900335.

Fish and benthic macroinvertebrate populations in the littoral zone of Fort Loudoun Lake were sampled in 1982 to determine the impact of shoreline modification structures on the abundance and diversity of these organisms. Fish populations were collected along natural (undisturbed) shoreline areas, retaining walls, and riprap areas by electrofishing and shoreline rotenoning, while benthos were collected at similar areas using artificial substrate samplers and a kick net. Riprap areas typically yielded the most fish in electrofishing samples, while natural areas usually had the most fish in the rotenone samples. Retaining wall areas usually yielded the fewest fish in both sampling schemes.

5206 Regulations

12343 (CONF-861066—1) Renovation of dilute process wastewaters: Mini-pilot plant evaluation of an integrated process system to meet the Clean Water Act's heavy-metal and organic treatment requirements at Oak Ridge National Laboratory. Begovich, J.M.; Brown, C.H. Jr.; Villiers-Fisher, J.F.; Thompson, W.T.; Patrick, G.C.; Snider, E.H. (Oak Ridge National Lab., TN (USA); Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Engineering-Science, Inc., Atlanta, GA (USA)). 1986. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002403.

From 47. international water conference; Pittsburgh, PA, USA (27 Oct 1986).

The purpose of the facility was to simulate the treatment the ORNL nonradiological wastewaters will receive in the NRWT plant. In the MPP, all wastewaters, with the exception of those not containing heavy metals (i.e., Cd, Cr, Cu, Fe, Pb, Hg, Ni, Ag, and Zn), flowed through an API-type separator. The criteria metals (except for mercury) were removed in the reactor/clarifier (R/C) as hydroxide precipitates using either calcium hydroxide (lime) and sodium carbonate (soda ash) or sodium hydroxide (caustic). Over-

flow from the precipitator was then treated by dual-media (sand and anthracite) filters and adjusted to a pH of 7. Wastewaters that had been pretreated by ion exchange for radionuclide removal bypassed the first four unit operations and were combined with the other wastewaters prior to air stripping. Volatile organics were removed by air stripping in a packed tower, while heavy (nonvolatile) organics and mercury were removed in three serially connected GAC columns. An ion-exchange (IX) column was operated in parallel with the R/C in order to evaluate the long-term performance of a chelating, heavy-metal-selective resin. In general, results of the MPP studies correlated well with those of the bench-scale treatability studies. The remainder of this paper details: the results of selected bench-scale treatability studies; spiking of feed streams; the MPP flowsheet and description of equipment; the results from the two MPP campaigns; and finally, the conclusions formulated by this treatability work.

53 Social And Economic Studies

REFER ALSO TO CITATION(S) 11462

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 12308

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 12518, 12985

5502 Biochemistry

REFER ALSO TO CITATION(S) 11005, 11026, 11027, 11028, 11797, 12373, 12376, 12377, 12379, 12386, 12387, 12394, 12395, 12398, 12399, 12409, 12520

12344 **(DOE/EV/05888—8) [Impact of energy related pollutants on chromosome structure]: Progress report.** Rill, R.L. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). [1986]. Contract AS05-78EV05888. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003917.

Studies of the structure of nucleosome cores using chymotrypsin as a probe of hydrophobic residues showed that only leu-20 of H3 was readily accessible. Primary sites of cleavage of H2a, H2b, and H4 were identified. Chymotrypsin removal of specific histone termini showed that removal of the amino-terminal plus the carboxy-terminal 13 residues of H2a caused little unfolding. Using carbon-13 NMR spectroscopic, about 10% of histone amino acid residues were found to be in termini that are highly mobile. The major mobile segments were amino terminal regions of H3 and H2a, plus a carboxy-terminal region of H2a. The histone variants and developmental changes during embryogenesis of sea urchin were characterized. The early histone gene organization in L. variegatus was characterized, a genomic library was cloned in lambda phage, and several histone gene clones were selected. The nucleosome core length DNA forms crystalline phases at physiological concentrations. Microscopic and NMR spectroscopic methods were used to identify crystalline phases and to establish phase diagrams for transitions between phases as functions of DNA concentration and temperature. The sequence specificities of binding of several polycyclic aromatic chemicals to early H3 and H2a genes were examined. Chemicals studied were the bis-(o-phenanthroline) Cu(I) complex, AAAF, benzopyrene dihydrodiol epoxide, methylene blue, and acridine orange A preliminary map of binding sites of CuOP, AAAF and BPDE in and near the H3 gene showed that several sequence regions were bound preferentially by two or more of these chemicals. CuOP appeared to exhibit the most specificity. 80 refs., 4 figs.

12345 **Transport in Rhizobium and its significance to the legume symbiosis.** Dilworth, M.J.; Glenn, A.R. (Murdoch Univ., Australia). pp 53-61 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

An effectively nodulating rhizobial strain lives both as a saprophyte in soil and as a symbiotic partner with a legume. In order to compete and persist in soil rhizobia have to obtain nutrients from generally very dilute soil solutions. In the nodule the bacteroid needs to take up such organic and inorganic materials as are presented to it by the plant, in order to grow, divide and fix N_2. The interface with both the soil and the plant cytoplasm is the bacterial cell surface which regulates the import and export of materials. Such exchanges, while important to an understanding of rhizobial behavior, have thus far received relatively little attention. Transport in rhizobia appears to be active and dependent on an energized membrane. However, while reports of transport of particular molecules being sensitive to carbonyl cyanide m-chlorophenylhydrazone (CCCP), 2,4-dinitrophenol, cyanide or azide are common, there is little evidence showing Δ pH or Δ psi measurements associated with the movement of organic molecules. Currently there are no data on the stoichiometry of the transport of particular organic compounds with the movement of other ions like H^+ or Na^+. 48 references, 3 tables.

12346 **Genes used in Rhizobium-plant interactions.** Long, S.R.; Jacobs, T.W.; Egelhoff, T.T.; Tu, J.; Fisher, R. (Stanford Univ., CA). pp 74-82 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Genes of both Rhizobium and its plant host are required for the formation of nodules. The authors have a preliminary knowledge of where the bacterial genes are located, and studies so far have shown that some of the genes are useful for the invasion of more than one host plant. These genes, and a segment of DNA which appears to influence host determination, are linked to the nitrogenase genes on the Rhizobium meliloti megaplasmid. Analyses of RNA indicate that the common nod gene loci are feebly expressed, if at all, in free-living cells, raising the possibility that regulation of nod gene expression may be an important feature of nodule development. The advent of molecular genetic techniques in Rhizobium research should be of assistance to other areas such as surface biochemistry, if the authors can provide strains with elevated expression of the gene products used in nodulation. This combination of approaches should help lead research on Rhizobium-plant interactions towards the level of understanding which has been achieved in nitrogen fixation biochemistry. 23 references, 2 figures.

12347 **Forty-nine years on the trail of nitrogenase.** Burris, R.H. (Univ. of Wisconsin, Madison). pp 101-110 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

The biochemistry of nitrogenase is presented with emphasis of the role of nitrogenase in nitrogen fixation. Included in the discussion are enzyme activity, purification, substrates for nitrogenase, as well as a variety of inhibitors. 59 references, 1 figure.

12348 **Comparison of the two hydrogenases of Clostridium pasteurianum.** Mortenson, L.E.; Adams, M.W.W. (Exxon Research and Engineering Co., Clinton, NJ). pp 111-120 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

This paper describes some of the properties of the two hydrogenases (I and II) of C. pasteurianum, I functioning in H_2 oxidation and H^+ reduction and II functioning primarily in H_2 oxidation. II has two 4Fe-4S centers whereas I has three. A comparison of the properties of I and II, i.e., spectral properties in various oxidation reduction states, kinetic properties, chemical properties and response to changing H^+ concentration, have suggested that the difference between the two may reflect the presence of a specific proton donating site in I that is missing in II. A 4Fe-4S center present in I but not II may be involved in proton availability and proton transfer to the active site. 11 references, 5 figures, 2 tables.

12349 **H_2-oxidizing hydrogenases of aerobic N_2-fixing microorganisms.** Arp, D.J. (Univ. of California, Riverside). pp 121-131 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

A close relationship between N_2 fixation and H_7 metabolism has been recognized for many years. Nitrogenase catalyzes the reduction of protons to H_2 simultaneous with the reduction of N_2 to NH_3. Exploitation of hydrogenases as a mechanism for improving the efficiency of biological N_2 fixation will require detailed knowledge of the physiology, biochemistry and genetics of H_2 metabolism in the microorganisms responsible. In addition, the role of the plant and the influence of the environment must also be defined. The purpose of this manuscript will be to review the literature relevant to the enzymology of hydrogenases from aerobic N_2-fixing microorganisms. 66 references, 2 tables.

12350 **Characterization of molybdopterin, the organic portion of the molybdenum cofactor.** Hageman, R.V.; Rajagopalan, K.V. (Duke Univ., Durham, NC). pp 133-141 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

A procedure is described for the separation of the molybdenum cofactor from protein, and a partial purification of the active material. The final product can be obtained in the absence of reducing agents or organic compounds, and is stable for weeks at -70°C, thus facilitating characterization. This active material is shown to contain a pterin nucleus, an organically bound phosphate residue and at least one, probably two, sulfurs, in the form of thiols. Based on comparison to the oxidized pterins isolated from molybdoenzymes, this conclusively establishes the active cofactor to be a substituted pterin. In spite of references in the literature to a polypeptide constituent of the cofactor, attempts to identify a small peptide in the isolated, active cofactor gave negative results. 12 references, 5 tables.

12351 **Biochemistry of higher plant nitrate reductase.** Campbell, W.H. (State Univ. of New York, NY). pp 143-151 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Higher plants acquire most of their nitrogen by taking nitrate, reducing it to ammonium and then fixing the ammonium into amino and amide nitrogen. The reduction of nitrate to ammonium is a two step process with the first step catalyzed by pyridine nucleotide nitrate reductase: and the second step catalyzed by ferredoxin nitrite reductase in the chloroplast. The fixation of ammonium takes place mostly in the chloroplast and occurs via the action of glutamine synthetase, which catalyzes the ATP-dependent amidination of glutamate to form glutamine. While the bulk of the glutamine amide-N is transferred to 2-oxoglutaeate to form glutamate in a ferredoxin dependent reaction catalyzed by glutamate synthase, glutamine can also donate its amid-N in several other reactions or even be totally consumed itself in some biosynthetic reactions. In the green leaf cells of higher plants, photorespiration is also a source of ammonium which is produced when two glycines condense to form serine, carbon dioxide and ammonium. Since in most cases the flux of ammonium from photorespiration is several fold greater than the flux from nitrate reduction, glutamine synthetase must fix ammonium into glutamine at a much higher rate than nitrate is reduced to ammonium if the green parts of the plant are to have net accumulation of reduced N. Since nitrate reductase is present in plant tissues with an activity capacity usually about ten times greater than nitrate reductase, the first step of the pathway (i.e. reduction of nitrate to nitrite) is the rate limiting step in assimilation of nitrate and appears to be the key regulatory site. Thus, a great deal of effort has been expended over the past thirty years in the study of the physiology and biochemistry of higher plant nitrate reductase. 26 references, 1 figure.

12352 **Unique, one-step, double isomerization (2E, 4Z $\rightleftharpoons$ 2Z, 4E) of 6-oxo-2,4-heptadienoic acid catalyzed by maleylacetone cis-trans isomerase.** Feliu, A.L.; Smith, K.J.; Seltzer, S. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **106**: 3046-2047(1984).

In order to examine the structural requirements of the enzyme, maleylacetone cis-trans isomerase, the enzyme, 6-oxo-2,4-heptadienoic acids, and its methyl esters were synthesized to provide the four possible cis-trans isomeric skeletons. The compounds are reported. The reported results suggest that the enzyme binds maleylacetone in the region of the 6-oxo function as well as by its carboxyl group. 6 references, 1 figure.

5503 Cytology

12353 **Radiolabeled red blood cells: status, problems, and prospects.** Srivastava, S.C. (Brookhaven National Lab., Upton, NY). pp 363-392 of Radiolabeled cellular blood elements. Takur, M.L.; Ezikowitz, M.D.; Hardeman, M.R. New York, NY; Plenum Press (1985). (CONF-8308156—).

From NATO advanced study institute on radiolabeled cellular blood; Maratea, Italy (29 Aug 1983).

The authors present in two tables a listing of the various radiolabels for red blood cells and a listing of the diagnostic applications of radiolabeled red blood cells. The major portion of the article deals with random labels, such as Chromium-51, Indium and Gallium, Technitium-99, and miscellaneous others. Only a brief discussion of cohort labels is provided.

5504 Genetics

REFER ALSO TO CITATION(S) 12346, 12372, 12378, 12385, 12403

12354 **Transfer of plasmids to an antibiotic-sensitive mutant of Zymomonas mobilis.** Buchholz, S.E.; Eveleigh, D.E. (Rutgers Univ., New Brunswick, NJ). *Applied and Environmental Microbiology;* **52**: No. 2, 366-370(Aug 1986).

Wild-type strains of Zymomonas mobilis exhibit multiple antibiotic resistance and thus restrict the use of many broad-host-range plasmids in them as cloning vehicles. Antibiotic-sensitive mutants of Z. mobilis were isolated and used as hosts for the conjugal transfer of broad-host-range plasmids from Escherichia coli. Such antibiotic-sensitive strains can facilitate the application of broad-host-range plasmids to the study of Z. mobilis.

12355 **Structure of a conjugative element in Streptococcus pneumoniae.** Vijayakumar, M.N.; Priebe, S.D.; Guild, W.R. (Duke Univ., Durham, NC). *Journal of Bacteriology;* **166**: No. 3, 978-984(Jun 1986). Contract AS05-76EV03941.

The authors have cloned and mapped a 69-kilobase (kb) region of the chromosome of Streptococcus pneumoniae DP1322, which carries the conjugative Omega(cat-tet) insertion from S. pneumoniae BM6001. This element proved to be 65.5 kb in size. Location of the junctions was facilitated by cloning a preferred target region from the wild-type strain Rx1 recipient genome. This target site was preferred by both the BM6001 element and the cat-erm-tet element from Streptococcus agalactiae B109. Within the BM6001 element cat and tet were separated by 30 kb, and cat was flanked by two copies of a sequence that was also present in the recipient strain Rx1 DNA. Another sequence at least 2.4 kb in size was found inside the BM6001 element and at two places in the Rx1

genome. Its role is unknown. The ends of the BM6001 element appear to be the same as those of the B109 element, both as seen after transfer to S. pneumoniae and as mapped by others in pDP5 after transposition in Streptococcus faecalis. No homology is seen between the ends of the BM6001 element and no evidence found suggesti hat it ever circularizes.

12356 **Cloning and physical characterization of chromosomal conjugative elements in streptococci.** Vijayakumar, M.N.; Priebe, S.D.; Pozzi, G.; Hageman, J.M.; Guild, W.R. (Duke Univ., Durham, NC). *Journal of Bacteriology;* **166**: No. 3, 972-977(Jun 1986). Contract AS05-76EV03941.

A directed insertion method was used to introduce a nonreplicating vector plasmid into the large conjugative cat-tet element found in the chromosome of Streptococcus pneumoniae BM6001 and derivatives. To direct insertion preferentially to the conjugative element, we transferred it by conjugation to Streptococcus faecalis and then used DNA from this strain as a source of restriction nuclease fragments for ligation to digests of the vector pVA891, which can replicate in Escherichia coli but not in streptococci. This ligation mix was used to transform pneumococcal cells carrying the cat-tet element, with selection for the erythromycin resistance carried by pVA891. Eight such isolates were found, and transformation and conjugation tests showed that in each case the vector had inserted into the conjugative element, as expected. DNA from these pneumococcal strains generated a variety of E. coli plasmids which provide tools for obtaining a detailed restriction map and for defining other structural features of the streptococcal conjugative element.

12357 **Nucleotide sequence, transcript mapping, and regulation of the RAD2 gene of Saccharomyces cerevisiae.** Madura, K.; Prakash, S. (Univ. of Rochester, NY). *Journal of Bacteriology;* **166**: No. 3, 914-923(Jun 1986). Contract FG02-85ER60281.

The authors determined the nucleotide sequence, mapped the 5′ and 3′ nRNA termini, and examined the regulation of the RAD2 gene of Saccharomyces cerevisiae. A long open reading frame within the RAD2 transcribed region encodes a protein of 1031 amino acids with a calculated molecular weight of 117,847. A disruption of the RAD2 gene that deletes the 78 carboxyl terminal codons results in loss of RAD2 function. The 5′ ends of RAD2 mRNA show considerable heterogeneity, mapping 5 to 62 nucleotides upstream of the first ATG codon of the long RAD2 open reading frame. The longest RAD2 transcripts also contain a short open reading frame of 37 codons that precedes and overlaps the 5′ end of the long RAD2 open reading frame. The RAD2 3′ nRNA end maps 171 nucleotides downstream of the TAA termination codon and 20 nucleotides downstream from a 12-base-pair inverted repeat that might function in transcript termination. Northern blot analysis showed a ninefold increase in steady-state levels of RAD2 mRNA after treatment of yeast cells with UV light. The 5′ flanking region of the RAD2 gene contains several direct and inverted repeats and a 44-nuclotide-long purine-rich tract. The sequence T G G A G G C A T T A A found at position - 167 to -156 in the RAD2 gene is similar to at sequence present in the 5′ flanking regions of the RAD7 and RAD10 genes.

12358 **DNA repair genes of mammalian cells.** Thompson, L.H.; Brookman, K.W.; Salazar, E.P.; Fuscoe, J.C.; Weber, C.A. (Lawrence Livermore National Lab., CA). *Basic Life Sciences;* 349-358(1986).

In the Chinese hamster ovary (CHO) cell line, various mutations affecting DNA repair have been obtained. Mutants that belong to 5 genetic complementation groups for ultraviolet (UV) sensitivity and resemble the cells from individuals having the cancer-prone genetic disorder xeroderma pigmentosum (XP) were previously identified. Each mutant is defective in the incision step of nucleotide excision repair and hypersensitive to bulky DNA lesions. These UV mutants can be divided into two subgroups; only Groups 2 and 4 are extremely sensitive to mitomycin C and other DNA cross-linking agents. The clear-cut phenotypes of the CHO mutants have allowed us to construct hybrid cells by fusion with human lymphocytes and thereby identify which human chromosomes carry genes that correct the CHO mutations. The first two mutations analyzed, UV20 (excision-repair deficient; UV Group 2) and EM9, which has a very high frequency of sister chromatid exchange (SCE), are both corrected by chromosome 19. Efforts are underway to isolate complementing repair genes by DNA-mediated gene transfer. The human gene that corrects mutant EM9 and the hamster gene that corrects UV135 (UV Group 5) have been introduced by cotransfer of genomic DNA and the dominant selectable marker gpt (guanine phosphoribosyltransferase) gene. In each case, the DNA repair function was co-selected based on resistance to 5-chlorodeoxyuridine (CldUrd) or repeated UV irradiation, respectively. The presence of a functional human repair gene in the EM9 transformants is shown by the presence of common human DNA sequences on some fragments produced by restriction enzyme cleavage. In UV135, transfer of a repair gene is indicated by a colony distribution containing jackpots and by instability of the resistant phenotype.

12359 **Molecular genetic analysis of nodulation genes of Rhizobium meliloti.** Kondorosi, A.; Kondorosi, E.; Banfalvi, Z.; Putnoky, P.; Toeroek, I. Schmidt, J.; John, M. (Hungarian Academy of Sciences, Szeged). pp 91-98 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

In R. meliloti the majority of symbiotic genes are located on the sym megaplasmid. Genes coding for early functions in nodulation, genes influencing nodulation efficiency, the nif structural genes and adjacent fix (probably nif) genes are located on a 90 kbp region of the megaplasmid. The essential nodulation genes are arranged into two clusters. One cluster is conserved in several Rhizobium species and code for common nodulation functions. The common nod region contains probably 3 genes, nodA, B and C; moreover, nodulation is affected also by a DNA region located left to the common nod genes. The other nod cluster contains genes determining host range specificity of nodulation. Products of nod genes from both clusters act (and probably interact), at a very early stage of the nodulation process, such as root hair curling. Preliminary data suggest that nodulation genes cannot express under normal growth conditions without the plant. Recent comparison of nucleotide sequence data from the putative promoter regions of the nod genes revealed homologous sequences. Although S1 mapping and functional analysis of these promotes are necessary to find out the significance of these conserved sequences, it is tempting to speculate that these nod genes are subject to a specific control. 18 references, 4 figures.

12360 **Developmental status of bioassays in genetic toxicology: a report of Phase II of the US Environmental Protection Agency Gene-Tox program.** Brusick, D.; Auletta, A. (Environmental Protection Agency, Washington, DC). *Mutation Research;* **153**: 1-10(1985).

The Gene-Tox Program was structured around two phases of genetic test data evaluation. The first phase consisted of 36 Work Group reports, each evaluating the results and performance of a specific bioassay. The second phase consisted of a plan to summarize the information provided by the Work Groups. The Gene-Tox Coordinating Committee was to be responsible for Phase II, and several subgroups were assigned specific goals in implementing this analysis. This report deals with Goal I which is to identify the developmental status of the individual bioassays reviewed by the Gene-Tox Work Groups in the first phase of the Program. 5 references, 6 tables.

12361 **Plasmid vector for cloning in Streptococcus pneumoniae and strategies for enrichment for recombinant plasmids.** Balganesh, T.S.; Lacks, S.A. (Brookhaven National Lab., Upton, NY). *Gene;* **29**: 221-230(1984).

A new plasmid, pLS101, was constructed for use as a vector for cloning in Streptococcus pneumoniae. This plasmid carried two selectable genes, tet and malM, each of which contains two or more restriction sites for cloning. Insertional inactivation of the malM gene allowed direct selection of Tc/sup R/Mal$^-$ clones containing recombinant plasmids. Other means of enriching a recipient population for cells containing recombinant plasmids were examined. The effect of removing vector terminal phosphate in attempts

to clone heterogeneous DNA fragments, such as those from chromosomal DNA, was to abolish recombinant plasmid establishment altogether, presumably because donor DNA processing during entry into the cell prevented establishment of the hemiligated molecule. However, with homogeneous DNA fragments, such as those from plasmid or viral DNA, vector phosphate removal allowed enrichment for recombinant plasmids. In the cloning of heterogeneous DNA that was homologous to the recipient chromosome (i.e. chromosomal DNA from S. pneumoniae), recovery of recombinant plasmids could be enriched tenfold (relative to the regenerated vector) by the process of chromosomal facilitation of plasmid establishment. This involved an additional passage of the mixed plasmids in which interaction with the chromosome of plasmids containing chromosomal DNA inserts (i.e. recombinant plasmids) increased their frequency of establishment relative to the vector plasmid. An overall strategy for cloning in S. pneumoniae, depending on the nature of the fragment to be cloned, is proposed.

12362 **Molecular organization of nuclear and cell organelles fungal ribosomal RNA genes.** Dutta, S.; Bollon, A.P. (Howard Univ., Washington, DC). *Nucleus (Calcutta);* **27**: No. 1-2, 6-19(1984).

There are about 20,000-30,000 unique structural genes in a typical fungal organism like Neurospora or yeast. An analysis of fungal chromosomal rRNA gene repeat units (rDNA) suggests that they have the typical 5 x 8S, 16-18S, and 26-28S conserved sequences. In addition, these rRNA gene clusters contain Internal Transcribed Spacer (ITS) regions of 500-1000 nucleotide base pair (bp) size, which also contain the 5.8S rRNA gene. Thus, one transcribed repeat unit of rDNA containing the rRNA genes is approximately 6 kilobase pair (kb) in some fungal species. In yeast, an additional 5S rRNA gene is included in the 6 kb repeat unit. In many fungi, rRNA genes exist in multiple copies of 100-450. Each of the repeat units of rRNA genes is separated from each other by External Transcribed Spacer (ETS) and a stretch of External Non-transcribed Spacer (ENTS) region of 2-5 kb sizes. These ITS, ETS or ENTS regions are variable regions which may provide species specific characteristics for fungal taxonomy. Nuclesomal structures of rDNAs also conform to other chromosomal genes. Extrachromosomal rRNA genes of Physarum or Tetrahymena are organized as 5′→3′ ES 3′→5′ (pallindromes). Ribosomal RNA genes are also located within mitochondrial genomes of fungal species, as single copies comprising mostly 16S and 26S rRNA genes which are separated from each other by long stretches of DNA sequences of 1-5 kb size.

5505 Metabolism

REFER ALSO TO CITATION(S) 11027, 12347, 12348, 12349, 12351, 12359, 12417, 12418, 12522

12363 (INIS-BR—567, pp 37-38) **Carbon (^{14}C) flux in the soil/plant/atmosphere system of sugar cane.** Cerri, C.C.; Eduardo, B.deP. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12364 (INIS-BR—567, pp 39-40) **Effects of water stress on the photosynthetic assimilation and distribution of ^{14}C-photosynthate in maize (Zea mays L.) and bean (Phaseolus vulgaris L.).** Martinez y Huaman, C.A.; Cerri, C.C. (Universidad Nacional Agraria, Lima, Peru; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12365 (INIS-BR—567, pp 69) **Hydrogen absorption by Azolla-Anabaena.** Ruschel, A.P.; Freitas, J.R. de; Silva, P.M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12366 (INIS-BR—567, pp 70-71) **Evaluation of Non-N_2-fixing controls for the isotope dilution technique.** Henson, R.; Heichel, G.H. (Empresa Brasileira de Pesquisa Agropecuaria, Goiania. Centro Nacional de Pesquisa de Arroz - Feijao; Minnesota Univ., Minneapolis, USA). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12367 (INIS-BR—567, pp 72-73) **Estimates of symbiotic nitrogen fixation in Phaseolus beans using the ^{15}N natural variation method.** Trivelin, P.C.O.; Victoria, R.L.; Saito, S.M.T.; Shearer, G.B. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Washington Univ., St. Louis, MO, USA). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12368 (INIS-BR—567, pp 74-75) **Symbiotic nitrogen fixation in varzeas of the Amazon River. A possible source of N-NO_3 for the river.** Martinelli, L.A.; Trivelin, P.C.O.; Victoria, R.L.; Shearer, G.B.; Richey, J.E. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Washington Univ., St. Louis, MO, USA; Washington Univ., Seattle, USA). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12369 (INIS-BR—567, pp 79-80) **^{35}S utilization in bean crops inoculated with species of mycorhiza.** Peron, S.C.; Portugal, E.P.; Saito, S.M.T. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12370 (INIS-BR—567, pp 81-82) **Biological N_2 fixation and ^{15}N mineral absorption by bean (Phaseolus vulgaris L.) varieties.** Fonseca, S.M.; Saito, S.M.T.; Trivelin, P.C.O. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12371 (INIS-BR—567, pp 76) **Analysis of RNA biosynthesis in tobacco cell infected by pimiento ring virus.** Silva, D.M.; Nogueira, N.L.; Lage, G. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Escola Superior de Agricultura de Lavras, Minas Gerais, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12372 **Biochemical characterization, evaluation, and genetics of H_2 recycling in Rhizobium.** Evans, H.J.; Hanus, F.J.; Russell, S.A.; Harker, A.R.; Lambert, G.R.; Dalton, D.A. (Oregon State Univ., Corvallis). pp 3-12 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

The hydrogenase system in Hup^+ strains of Rhizobium japonicum catalyzes the oxidation of H_2 to H_2O via a pathway which includes components of normal respiratory electron transport chain. In addition to the hydrogenase Hup^+ strains contain a cytochrome b-559 which appears to be uniquely associated with a functional hydrogenase system. An experiment in which a Hup^+ R. japonicum mutant was compared with a stable Hup^+ derivative of the mutant as inoculants for soybean in large cylinders (10 replicates) has revealed statistically significant increases in weights and N contents of seeds, leaves and total plant material from use of the Hup^+ strain. Since possession of the H_2 uptake system seems to benefit the N_2 fixation process, the authors have attempted to transfer hup genes to those species and strains lacking an effective H_2 system. From a gene bank of R. japonicum 122DES DNA, a series of cosmids have been isolated which contain insert DNA that complements several Hup^- mutants of R. japonicum. From transposon mutagenesis they have concluded that Hup specific sequences span about 16 kb of the total 25 kb insert in cosmid pHU1. Since the transfer of pHU1 into wild-type and some mutants of Rhizobium fails to confer Hup activity, more cosmids with additional adjacent DNA have been isolated and are being characterized. Some of these may contain most of, if not all, the hup determinants. 48 references, 1 figure, 2 tables.

12373 **Factors affecting functional leghemoglobin in legume nodules.** Klucas, R.V.; Lee, K.K.; Saari, L.; Erickson, B.K. (Univ. of Nebraska, Lincoln). pp 13-20 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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The main functions of leguminous root nodules are nitrogen fixation and assimilation. Leghemoglobin (LB), a myoglobin-like protein, is invariably associated with nodules from nitrogen-like protein, is invariably associated with nodules from nitrogen-fixing legumes. Although not necessarily conclusive, evidence supports a dual location of LB within infected cells with the majority of LB located outside the peribacteroid membrane envelope and the remainder inside the envelope but outside the bacteroids. The apparent function of LB in nodules is to facilitate the diffusion of O_2 to the O_2-requiring bacteroids. The authors are investigating the forms of LB in leguminous nodules and the processes that maintain LB in the functional ferrous form. 20 references, 3 figures, 2 tables.

12374 **Characterization of carbon metabolism in Rhizobium japonicum bacteroids.** Emerich, D.W. (Univ. of Missouri, Columbia). pp 21-30 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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The metabolism of photosynthate by nodule tissues and bacteroids is not well characterized nor is it known in which symbiont or subcellular organelle the relevant metabolic reactions occur. Isolated suspensions of bacteroids are capable of utilizing a wide variety of carbon compounds to support respiration and nitrogen fixation activity. Although sucrose and glucose are the primary photosynthetic products that are transported to the roots of soybean nodules, organic acids particularly succinate, malate, and fumarate promote greater rates of respiration and nitrogen fixation in isolated bacteroid suspensions. Genetic evidence supports the concept that organic acids of the citric acid cycle are necessary for symbiotic nitrogen fixation. This article will discuss recent results from this laboratory concerning particular enzymes of the citric acid and poly-β-hydroxybutyrate cycles of Rhizobium japonicum bacteroids. 25 references, 3 figures, 2 tables.

12375 **Uninfected cells in ureide- and amide-exporting legume root nodules.** Newcomb, E.H.; Selker, J.M.L.; Tandon, S.R.; Meng, F.J.; Kowal, R.R. (Univ. of Wisconsin, Madison). pp 31-40 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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There are numerous developmental and structural differences between the nodules of the amide and ureide exporters, it is a characteristic of both groups and of the nodules of most legumes that many of the cells in the central infected region remain uninfected throughout nodule life. An attempt is made to characterize those features of mature nodules which provide evidence bearing on the types of controls in effect during development of uninfected cells. Some quantitative information on the differences in organelle volume and number between uninfected and infected cells of soybean nodules is presented which will define the extent of the ultrastructural divergence that develops for three key organelles: mitochondria, plastids and peroxisomes. 21 references, 2 figures, 2 tables.

12376 **Plant hemoglobin properties, function, and genetic origin.** Appleby, C.A. (CSIRO, Canberra, Australia). pp 41-51 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Attention is focused on the following questions in relation to nitrogen fixation. 1. Is the respiratory system of the root nodule bacteria similar to that found in other microorganisms and tissues, or is the function of nitrogen fixation uniquely associated with an unusual type of respiration? 2. Are there fundamental differences in the respiratory systems of the different species or strains of the root nodule bacteria which might be correlated with the observed specific differences in their ability to fix nitrogen in association with the various legumes? 3. Do differences exist in the respiratory system of a given strain when grown on laboratory medium in comparison with growth in association with the plant? 51 references, 3 tables.

12377 **Biochemical genetics of nitrogen fixation of Klebsiella pneumoniae.** Brooks, S.J.; Imperial, J.; Brill, W.J. (Univ. of Wisconsin, Madison). pp 65-74 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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Of all the nitrogen-fixing organisms studied, Klebsiella pneumoniae is the best understood from the biochemical, genetic, regulatory and molecular biological points of view. It has been interesting to follow the sequence of many of the key discoveries, since a discovery regarding the biochemistry of nitrogen fixation has frequently led to an appreciation for the genetics and regulation of the system. Likewise, mutants have been invaluable to open up the complexity of the biochemistry of nitrogen fixation. As more nucleotide sequences are being worked out, hypotheses as to the molecular bases for the very interesting regulatory phenomena should begin to be solved. Even though progress with all aspects of nif has been rapid, there are a number of fascinating problems that will take another decade or two to solve. This article will highlight some of the recent developments and point out a number of questions yet to be answered. 65 references, 1 figure.

12378 **Organization of the genes for nitrogen fixation in cyanobacteria and photosynthetic bacteria.** Haselkorn, R.; Golden, J.; Robinson, S.J.; Avtges, P.; Kranz, R.G.; Scolnik, P.A. (Univ. of Chicago, IL). pp 83-90 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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The authors have studied the organization of the nif genes in the filamentous cyanobacterium Anabaena, in which nitrogen fixation, under aerobic conditions, occurs in heterocysts. These specialized cells differentiate at regular intervals along each filament when the cells are starved of combined nitrogen. Until recently no gene transfer system was available for genetic analysis of Anabaena, so their information about nif gene organization and expression has been based entirely on recombinant DNA experiments, using cloned genes from Klebsiella to identify and clone homologous DNA from Anabaena. The cloned Anabaena nif DNA was subsequently used for three purposes: to analyze the regulation the regulation of nif gene transcription, to define nif gene promoters, and to study the rearrangement of the nif genes during heterocyst differentiation. The authors have also studied the organization and regulation of the nif genes in the photosynthetic bacterium Rhodopseudomonas capsulata. This organism has several interesting features: it fixes nitrogen and carbon dioxide at the same time, it exchanges genes with E. coli, and it harbors a defective transducing phage called GTA (for Gene Transfer Agent) that makes site-specific insertion or deletion mutagenesis extremely efficient. They have exploited these genetic tools to identify and to clone the genes coding for the nitrogenase complex (nifH, D, K) as well as three other nif genes. One of the latter is a regulatory gene. These genes are much more widely dispersed than the nif genes of Klebsiella. Moreover, R. capsulata contains multiple copies of sequences related to nifH, D, and K. 20 references, 3 figures, 2 tables.

12379 **Mechanism and structure of nitrogenase Fe-protein.** Howard, J.B.; Deits, T.L.; Anderson, G.L.; Maroney, M.; Que, L.; Hausinger, R.P. (Univ. of Minnesota, Minneapolis). pp 153-162 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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The nitrogen fixation complex contains two enzyme components: MoFe-protein (component 1 or dinitrogenase) is the site of substrate reduction and Fe-protein (component 2 or dinitrogenase reductase) is the ATP-dependent reductant of the MoFe-protein. The Fe-protein is a dimer of identical, M/sub r/ = 30 - 33,000 subunits. The protein contains 4 Fe and inorganic S which can be extruded as a 4Fe:4S cluster in denaturing solvents (1). Transfer of electrons between Fe-protein and MoFe-protein is a highly specific reaction which requires a number of criteria to be satisfied. For example, electron transfer is intimately connected to ATP hydrolysis. MgATP binding reduces the redox potential of the Fe-protein to ~-400 mV; yet the lower redox potential cannot be the sole driving force for the transfer. This suggests that the redox potential of the Fe-protein is expressed only in the ternary complex, [Fe-protein ATP MoFe-protein]. For electron transfer, there are several restraints on the protein structures. Although the Fe-proteins from different species have similar amino acid sequences, they are not equally active in heterocomplexes with the MoFe-protein. Some Fe-proteins have little or no activity in heterocomplexes but are potent competitive inhibitors of homocomplexes. In this paper, the authors describe some of the properties of the Fe-proteins from Azotobacter vinelandi (Av2) that may be related to the formation of and reactions in the active complex.

12380 **Utilization of photosynthate for nitrogen fixation in seedlings of Myrica gale and Alnus rubra.** Tjepkema, J.D. (Univ. of Maine, Orono). pp 183-192 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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A large amount of energy is consumed during nitrogen fixation, which is thus an important component of the energy budgets of all nitrogen-fixing organisms and symbioses. Although the energy cost of nitrogen fixation in legumes has been extensively studied, there is little information on actino-rhizal plants, which differ from the legumes in several important characters including anatomy, endophyte, and oxygen regulation. In this study data are presented on the energy cost of the nitrogen fixation in seedlings of two actinorhizal plants as a function of seedling age. 19 references, 10 figures.

12381 **Intersymbiotic transport processes in nitrogen-fixing root nodules.** Quispel, A.; Van Brussel, A.A.N.; Hooymans, J.J.M.; Priem, W.J.E.; Staal, H.J.M. (State Univ. of Leiden, Nonnensteeg, Netherlands). pp 193-202 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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In this paper the authors will try to give some impression of the nutrient flows between the endophytic forms of the diazotrophic symbiotic microorganisms and their hosts realizing that such nutrient flows can only be established as an essential part of the regulatory mechanisms. It is only by the integration into the regulatory mechanisms of host cells and endophytic symbionts that the complicated structure develops which provides the basis for the functional transport systems. In the Rhizobium-Leguminosae root nodules this structure consists of a peribacteroid membrane, which is formed from the plasmalemma of the host cells and the bacteroid cell envelope. The latter cell envelope consists of the bacterial cytoplasmic membrane and the cell wall with its outer membrane. Two interspaces may contain important components for transport: the periplasmic space between the bacterial cytoplasmic and outer membrane and the intersymbiontic space between the bacteroid outer-membrane and the peribacteroid membrane. In non-leguminous actinorhizae the situation may be still more complicated due to the complex structure of the cell wall of Frankia and the development of deposits of cell wall material on the plant membrane. 38 references, 3 figures.

12382 **Host legume control of Rhizobium function.** Phillips, D.A.; Bedmar, E.J.; Qualset, C.O.; Teuber, L.R. (Univ. of California, Davis). pp 203-212 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

In this report the authors describe results from two continuing studies directed toward producing legumes that will facilitate modern investigations of how the host legumes that will facilitate modern investigations of how the host legume can control symbiotic functioning of Rhizobium. One case in which the host pea (Pisum sativum L.) cultivar changes the uptake hydrogenase phenotype of R. leguminosarum may provide a basic understanding of one aspect of the Rhizobium-legume association. The other study, which involves the development of alfalfa populations that apparently can increase N_2 fixation by diverse strains of R. meliloti, could produce agronomically useful plant materials. It is possible that the improved alfalfa populations also will contribute to the authors basic understanding of the Rhizobium-legume association, but complexities associated with the autotetraploid genetic system in alfalfa will make that possibility more remote than in the simpler pea system. 40 references, 2 figures, 4 tables.

12383 **Nitrogen fixation by Desulfovibrio gigas and other species of Desulfovibrio.** Postgate, J.R.; Kent, H.M.; Hill, S.; Blackburn, H. (Univ. of Sussex, Brighton, England). pp 225-234 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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Some chemostat-bases studies on diazotrophy in Desulfovibrio are presented with emphasis on recent studies with Desulfovibrio gigas. The most unexpected observation is that Desulfovibrio gigas, despite its exacting anaerobic habit, shows reversible oxygen-induced switch-off of nitrogenase activity.

12384 **Heterocyst development and nitrogen fixation by mastigocladus laminosus.** Stevens, S.E. Jr.; Mehta, V.B.; Lane, L.S. (Pennsylvania State univ., University Park). pp 235-243 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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The authors have reported several of their observations on the similarities and differences between M. laminosus and Anabaena spp. The similarities and differences between M. laminosus and Anabaena spp. The most notable differences were the capacity of M. laminosus to form multiple heterocysts and to form heterocysts at frequencies within the higher range exhibited by symbiotic associations. These two phenomena probably reflect a lack of spatial control over heterocyst differentiation in M. laminosus. 40 references, 6 figures, 2 tables.

12385 **Dinitrogen fixation in methylotrophic bacteria.** Lidstrom, M.E.; Murrell, J.C.; Toukdarian, A.E. (Univ. of Washington, Seattle). pp 245-251 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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It is not known whether methylotrophs actively fix dinitrogen in their natural habitats, since they are often found in environments where dissolved inorganic nitrogen is relatively high. In order to assess the potential for these bacteria to contribute to the nitrogen budget in specific ecosystems, the authors have begun studies of the regulation and genetics of nitrogen fixation in two representative diazotrophic methylotrophs, Xanthobacter sp. H4-14 and Methylosinus sp. 6. Results indicate that methylotrophic nitrogenases are similar to the enzymes found in other diazotrophs. The cloning of nif DNA and the characterization of nif mutants in methylotrophs is the first step towards understanding the molecular basis of regulation of dinitrogen fixation in these bacteria.

12386 **Nitrogen fixation in Rhodospirillum rubrum: the regulation of Fe protein and its activating enzyme.** Kanemoto, R.H.; Saari, L.; Pope, M.; Paul, T.D.; Lowery, R.; Murrell, S.; Ludden, P.W. (Univ. of Wisconsin, Madison). pp 253-260 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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An attempt is made to examine the nitrogenase system in Rhodospirillum rubrum. In addition, a cascading pathway for the regulation of nitrogenase activity is demonstrated. The regulation of nitrogenase by covalent modification of the Fe protein offers a rapid mechanism for responding to changes in cell metabolism. Upon exposure to reduced nitrogen, the cell initiates a regulatory cascade to inhibit nitrogenase activity and thereby conserve ATP and reductant.

12387 **Electron transfer chains of cyanobacterial heterocysts.** Houchins, J.P. (Univ. of Minnesota, St. Paul). pp 261-268 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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During aerobic growth nitrogen fixation in cyanobacteria is confined to a specialized cell type, the heterocyst, which accounts for 5-10% of the cells in the filament. Upon differentiation of vegetative cells into heterocysts photosystem 2 is lost, however, photosystem 1 and the associated electron transfer chain is retained. Heterocysts also possess substantial respiratory activities, and a segment of the electron transfer chain between plastoquinone and plastocyanin/cyt c-553 is shared in common by the photosynthetic and respiratory chains. Electrons are donated to this common segment by NADH dehydrogenase and by a membrane bound uptake hydrogenase. Plastocyanin/cyt c-553 then donates electrons either to photosystem 1 or to a cyt aa_3-type cytochrome oxidase. This report examines details of the electron transport pathways through which hydrogen, NADH, and NADPH provide electrons for nitrogen fixation in heterocysts.

12388 **Physiological studies on N_2-fixing cyanobacteria.** Stewart, W.D.P.; Rowell, P.; Cossar, J.D.; Kerby, N.W. (Univ. of Dundee, Scotland). pp 269-279 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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N_2-fixing cyanobacteria are unique in that within the one organism and often within the one cell they carry out two of the major processes which sustain life on Earth: N_2 reduction to ammonia via the enzyme nitrogenase and oxygenic photosynthesis. The key enzymes involved closely resemble those of other organisms for nitrogenase; for the light reactions of photosynthesis and for ribulose 1,5-bisphosphate carboxylase/oxygenase (RuBisCO) and other Calvin Cycle enzymes. The ways in which such organisms are organized to satisfactorily perform these functions are of particular interest and concern. Here the authors summarize ways in which the heterocysts of cyanobacteria are organized to fix N_2, considering in particular, factors which may be implicated in the supply of reductant to nitrogenase, and aspects of NH_4^+ regulation of nitrogenase in cyanobacteria. 49 references, 4 figures, 2 tables.

12389 **Legume nodule carbon utilization in the synthesis of organic acids for the production of transport amides and amino acids.** Duke, S.H.; Henson, C.A. (Univ. of Wisconsin, Madison). pp 293-302 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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Legume root nodules use large amounts of carbohydrates during periods of active N_2 fixation. Minchin et al. estimate that up to 20 mg of carbon is used per mg n_2 fixed. Carbohydrates are used for energy production by both bacteroids and host plant portions of nodules. The host plant also utilizes carbohydrates for assimilation and transport of fixed N_2. This review deals primarily with the flow of carbon from its uptake by the nodule to its use in the synthesis of carbon skeletons for production of amides and amino acids containing fixed n_2 which are transported to the developing legume. The authors investigations have been primarily with the amide and amino acid transporting nodules of alfalfa (Medicago sativa L.); hence, they will emphasize this species. 60 references, 2 figures, 2 tables.

12390 **Stoichiometry of CO_2 evolution during photorespiratory carbon flow.** Peterson, R.B.; Hanson, K.R. (Connecticut Agricultural Experiment Station, New Haven). pp 311-320 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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This article concerns the inhibition of photosynthesis attributable to O^2-dependent photorespiration. Experiments were conducted using new methodology which demonstrate that in intact tissue the stoichiometry of CO_2 evolution during photorespiration is not fixed. The results strongly suggest that multiple sources of CO_2 may exist during photorespiration and that the relative contributions of the various sources to CO_2 evolution may be under environmental control. 23 references, 8 figures, 1 table.

12391 **Photoinhibition of N_2 fixation, photosynthesis, and the collapse of blue-green algal blooms.** Osmond, B.; Cooper, J.J.; Vigg, S.; Buchen-Osmond, C. (Univ. of Nevada System, Reno). pp 321-329 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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Although photoinhibition of photosynthesis has been investigated in non-N_2-fixing blue-green algae, there are no physiological studies of the simultaneous responses of N_2 fixation and photosynthesis to potentially inhibitory irradiance in blooming blue-green algae. The complex interdependency of N_2 fixation and photosynthesis in these algae is well known from laboratory studies, all of them done with low-light grown algae. In higher plants it is clear that photoinhibition, the light dependent inhibition of photosynthetic processes, is a major factor determining the stability and longevity of the autotrophic system. Furthermore low leaf nitrogen status limits the capacity for acclimation of leaves to high light, and predisposes leaves to photoinhibition. Extrapolating from these observations, the authors suggest that growth and stability of blue-green algal blooms in desert lakes might depend on the response of N_2 fixation to high light intensity. This paper describes preliminary experiments, and reviews others, which show N_2 fixation can be more sensitive to photoinhibition than is photosynthesis. They then speculate on the biochemical bases of this response, and on the role of photoinhibition in the demise of blue-green algal blooms. 44 references, 5 figures, 2 tables.

12392 **Oxidative photosynthetic carbon cycle and peroxisomal glycolate metabolism.** Tolbert, N.E. (Michigan State Univ., East Lansing). pp 333-341 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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The oxidative photosynthetic carbon cycle or the C_2 cycle has developed from investigations dealing with its 5 different parts: (a) The glycolate pathway begins with the P-glycolate biosynthesis from ribulose-P_2 and includes the metabolism of glycolate to glycine and serine; (b) The reversible glycerate pathway between the 3-PGA pool in the chloroplasts through serine formation in the peroxisomes and the formation of C_1-THF and glycine in the mitochondria; (c) The regeneration of ribulose-P_2 in the chloroplasts to utilize NADPH and ATP produced from the light reactions of photosynthesis; (d) Shuttles of respiratory metabolites between the subcellular compartments; (e) The photorespiratory nitrogen cycle which refixes the NH_3 generated during glycine oxidation. The C_2 cycle co-exists with the C_3 reductive cycle in a competitive ratio between the availability of CO_2 for the ribulose-P_2 carboxylase reaction and O_2 for the oxygenase. The two cycles are not independent, for they are controlled by this one bifunctional enzyme and use the same reactions and energy for regenerating the ribulose-P_2. Their major differences are outside the chloroplast where glycolate is metabolized in the C_2 cycle, whereas sucrose is synthesized as the end product of the reductive cycle. 25 references, 1 figure, 1 table.

12393 **Regulation of photosynthetic CO_2 assimilation and crop yield.** Zelitch, I. (Connecticut Agricultural Experiment Station, New Haven). pp 343-350 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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A cooperative effort is underway to increase net photosynthesis and hence growth in C_3 plants through rational changes in leaf biochemistry using genetic cell culture methods. The authors would like to produce crops with superior yields because they possess superior photosynthetic efficiency. They are attempting to obtain low photorespiration mutants from haploid tobacco tissue cultures and other systems using positive selection schemes, and are seeking to increase wheat yields greatly, using unconventional selection of parental types and conventional plant breeding methods. Some of this work will be described. 16 references, 1 figures, 6 tables.

12394 **Analysis of Chlamydomonas reinhardii mutants and defects in the CO_2 concentrating system.** Ogren, W.L.; Spalding, M.H.; Spreitzer, R.J. (Univ. of Illinois, Urbana). pp 351-357 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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Photosynthesis is stimulated and photorespiration is suppressed in Chlamydomonas reinhardii and other green algae by a multi-step pathway which concentrates CO_2 at the site of ribulose 1,5-bisphosphate (RuBP) carboxylase/oxygenase, thereby stimulating RuBP carboxylase activity and inhibiting RuBP oxygenase activity. Increased photosynthesis and reduced photorespiration in these organisms at air levels of CO_2 and O_2 are manifested by a high affinity for CO_2, a photosynthesis rate near the Vmax, absence of O_2 inhibition of CO_2 fixation, low rates of synthesis of photorespiratory products such as glycolate and glycine, and a CO_2 compensation concentration of near zero. The CO_2 concentrating system in Chlamydomonas is inducible, induction requiring a low CO_2 concentration, the capability of the angal strain to photosynthesize and the presence of O_2. Biochemical and physiological studies suggested the involvement of two components in the system, carbonic anhydrase and an energy-requiring bicarbonate or CO_2 transport process. In order to further characterize this CO_2 concentrating system, the authors have pursued an approach designed to identify and characterize mutant strains with defects in the system. 10 references, 3 tables.

12395 **Pyrophosphate-dependent glycolysis and regulation by fructose 2,6-bisphosphate in plants.** Black, C.C.; Smyth, D.A.; Wu, M.X. (Univ. of Georgia, Athens). pp 361-370 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

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Sugar conversions are fundamental in the authors understanding of plants because sugars support and feed into essentially all aspects of plant metabolism and growth. Indeed biochemical pathways for the interconversion of hexoses and trioses are so well known that one hardly expects to discover a new pathway of glycolysis, much less a new hexose bisphosphate with regulatory roles in sugar metabolism. Nor would one expect to learn that a common product of many biosynthetic reactions, namely pyrophosphate (PPi), is an energy source to drive glycolysis. Recent research has focused on these and other features of plant sugar metabolism which the authors will consider along with their current model for the regulation of cytoplasmic glycolysis. 28 references, 5 figures, 4 tables.

12396 **Metabolic modifications of crassulacean acid metabolism - CAM-idling and CAM-cycling.** Ting, I.P.; Sipes, D. (Univ. of California, Riverside). pp 371-378 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Crassulacean acid metabolism (CAM) is a variation of photosynthesis that has been studied for many years. During the last two decades, there has been intensified research stimulated by the discovery of C_4-photosynthesis and the realization that CAM and C_4 are similar in many respects. Two known modifications of the basic CAM pathway in terrestrial plants are termed CAM-idling and CAM-cycling. In both, there is organic acid fluctuation similar to CAM but little or no CO_2 uptake at night. CAM-idling was first observed in a cactus at Deep Canyon in 1973. It was noted that under severe water stress, the stomata of Opuntia bigelovii were closed day and night, yet there was a continued diurnal fluctuation of organic acids evidently through the CAM pathway. The fluctuation was measured over a 3-year period with no detectable CO_2 uptake day or night. The second phenomenon, not too unlike CAM-idling, is termed CAM-cycling and is characterized by diurnal fluctuation of organic acids in the manner of CAM, but virtual-

ly all CO_2 uptake is during the day and none at night. Thus, plants showing CAM-cycling appear as C_3 plants at the gas exchange level but as CAM plants when organic acid metabolism is observed. It is the purpose of this paper to discuss the CAM-cycling phenomenon in comparison with CAM and CAM-idling. 19 references, 6 figures, 2 tables.

12397 **Characteristics of CO_2 fixation and productivity of corn and soybeans.** Christy, A.L.; Williamson, D.R. (Monsanto Agricultural Products Co., St. Louis, MO). pp 379-387 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Grain yield is an integration of a large number of variables including weather, soil, fertility, genotype and physiology. Once the seed is planted, several of these variables are set and yield will primarily be the result of the physiology of the crop interacting with the weather. Photosynthesis has long been assumed to be one of the key physiological processes and the relationship between crop productivity and photosynthesis, has been the subject of recent reviews. Obviously, there is some relationship between photosynthesis and yield, however, to date, the exact nature of this relationship has remained elusive. Recently, the authors reported that yield was strongly dependent on seasonal photosynthesis in soybean in studies with plant density and shade treatment. Further studies with different cultivars of soybean and corn hybrids have revealed a more complex relationship between grain yield and canopy photosynthesis. The following is a summary of these studies, and they will compare and contrast the characteristics of photosynthesis, photosynthate partitioning, and yield in corn and soybeans. 11 references, 8 figures, 1 table.

12398 **Dicarboxylate transport into isolated pea chloroplasts.** Werner-Washburne, M.; Keegstra, K. (Univ. of Wisconsin, Madison). pp 389-397 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

The proper functioning of a plant cell requires substantial fluxes of various metabolites between the cytoplasm and the stromal space of chloroplasts. For some metabolites, such as nitrite and bicarbonate, this transport has been demonstrated to occur by diffusion of the uncharged form of the molecule across the membrane. For most metabolites, however, saturation of transport by the substrate and inhibition of transport is carrier-mediated. One of the most active of the chloroplast transport systems is the dicarboxylate transporter. An early model of dicarboxylate transport envisioned a single carrier with broad specificity. According to this model, the dicarboxylate carrier mediates the counter exchange of the dicarboxylates malate, oxaloacetate, 2-oxoglutarate, succinate and fumarate as well as the amino acids aspartate, glutamate and possibly glutamine and aspargine. More recently, work from several different laboratories has led to the conclusion that the simple model of a single dicarboxylate carrier is inadequate. The remainder of this manuscript discusses some of the evidence that supports the argument for multiple dicarboxylate carriers. 17 references, 1 figure, 2 tables.

12399 **Regulation of photosynthetic sucrose formation in leaves.** Huber, S.C.; Doehlert, D.C.; Kerr, P.S.; Kalt-Torres, W. (Dept. of Agriculture, Raleigh, NC). pp 399-407 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Regulation of the rate of sucrose formation in leaves appears to involve two types of mechanisms, viz. metabolic fine control, cytoplasmic fructose-1,6-bisphosphatase (FBPase) and sucrose phosphate synthase (SPS). Some of the options for metabolic regulation of the cytoplasmic sucrose formation pathway are summarized. An attempt is made to compare; the regulatory properties of SPS isolated from leaves of different species. Evidence is presented for diurnal rhythms in SPS activity in soybean leaves as one example of the coarse control of enzyme activity that may be related to a physiological process.

12400 **Photosynthesis in allopolyploid Festuca.** Randall, D.D.; Nelson, C.J.; Sleper, D.A.; Miles, C.D.; Crane, C.F.; Krueger, R.W.; Wong, J.H.H.; Poskuta, J.W. (Univ. of Missouri, Columbia). pp 409-433 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

This report describes the authors investigations on photosynthesis in cultivated and wild relatives of an allopolyploid C_3 forage grass, tall fescue, Festuca arundinace, Schreb. Tall fescue belongs to the Bovinae section of the genus Festuca; tribe Festuceae. It evolved in the area surrounding the Mediterranean Sea and is found in its native state in Europe, Tunisia and the west and central area of Asia and Siberia. The Festuca genus contains cultivated hexaploid and wild tetraploid, octoploid and decaploid varieties, all founded on a basic chromosome number of x=7. A diploid species, F. pratensis Huds., morphologically resembles F. arundinacea and probably contributed a genome to some polyploid fescues. The phylogenetic relationships among tall fescue and its relatives are not completely understood and with few known diploids, phylogenetic analyses of the polyploids are difficult. 288 references, 1 figure, 9 tables.

12401 **Aspects of nitrogen and carbon interchange in the Azolla-Anabaena symbiosis.** Peters, G.A.; Kaplan, D.; Meeks, J.C.; Buzby, K.M.; Marsh, B.H.; Corbin, J.L. (Battelle-C.F. Kettering Research Lab., Yellow Springs, OH). pp 213-222 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

The free-floating aquatic pteridophytes in the genus Azolla contain an N_2-fixing cyanobacterium, Anabaena azollae, as a symbiont. Six extant species usually are recognized. In each species the symbiotic Anabaena can provide the total N requirement of the association via N_2 fixation and the Azolla sporophytes are capable of prolific vegetative reproduction in the absence of a combined N source. While vegetative reproduction and growth is more common, sexual reproduction occurs and presumably provides a means for survival during unfavorable environmental conditions. Azolla is heterosporous, producing both megasporocarps and microsporocarps on the same plant. Species demarcation is based primarily upon the morphology of these structures. Anabaena filaments are partitioned into both types of sporocarps during their development. The endophyte within the megasporocarp provides an inoculum for the developing sporophyte, maintaining the symbiosis. This report is restricted to studies conducted with the vegetatively propagated Azolla caroliniana - Anabaena azollae symbiosis grown on medium without combined N. It focuses on recent approaches to further elucidate aspects of host-endophyte interaction and incorporates analyses of soluble amino acids and ammonium, assays of ammonia assimilating enzymes, the use of $[^{13}N]N_2$ and the analysis of soluble sugars as well as $^{14}CO_2$-pulse chase studies. For orientation purposes the results are preceded by a description of the symbiosis. 39 references, 3 figures, 3 tables.

12402 **In vivo energetics of symbiotic nitrogen fixation.** Heytler, P.G.; Reddy, G.S.; Hardy, R.W.F. (E.I. du Pont de Nemours & Co., Wilmington, DE). pp 283-292 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

This paper will summarize data on the in vivo energetics of symbiotic N_2 fixation and present data based on respirometric, calorimetric, and NMR studies of soybeans. Overall, symbiotic N_2 fixation in soybeans will be shown to use about 12 g CH_2O per g N_2

fixed. The authors will conclude with some projections of possible opportunities to make up to 75% reductions in the cost of symbiotic N_2 fixation. 12 references, 11 figures, 3 tables.

12403 **Breeding for enhanced dinitrogen fixation potential of common bean (Phaseolus vulgaris L.).** Bliss, F.A. (Univ. of Wisconsin, Madison). pp 303-310 of Nitrogen fixation and CO3" metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Nitrogen fertilizer is usually the most costly input for the production of common bean (Phaseolus vulgaris L.). When fertilizer becomes too expensive or is in limited supply, low yields result, since bean production is often relegated to areas with infertile soils. Increasing the N_2 fixation of common bean is an attractive approach to raising yields and reducing N fertilizer requirements. Measurements of N_2 fixed and various parameters of N_2 fixation suggest sufficient genetic variability among cultivated germplasm to allow improvement through selection. A problem encountered by breeders is the lack of rapid, accurate methods for measuring improvement criteria such as N_2 fixed per plant, proportion of total plant N from fixation and plant or seed production attributable to N_2 fixation. The inbred backcross line method of breeding has been used to produce populations of near-homozygous recombinant lines which were selected for enhanced N_2 fixation potential using acetylene reduction assays of field grown plants. Genetic analyses showed heritable differences for N_2 fixation parameters, traits supporting N_2 fixation and seed yield. Superior selected lines grown under low soil N conditions produced higher seed yields attributable to fixed N compared to the unimproved recurrent parent. Estimates of N_2 fixed using ^{15}N isotope dilution methods are being obtained from field experiments. 21 references.

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REFER ALSO TO CITATION(S) 11675, 12402, 12429, 12531

12404 **(BNL—38980) Activation of N, P, and A1 in patients and cadavers using radiation from the medical accelerator.** Wielopolski, L.; Meek, A.G.; Rothmann, J.C.; Reinstein, L.E. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA). Dept. of Radiation Oncology). 1986. Contract AC02-76CH00016. 12p. (CONF-8609203—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003479.

From International symposium on in vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The present work demonstrates that it is possible to monitor the activity of N and P following photoactivation of an anthropomorphic phantom, a patient, and five cadavers. Analysis of the annihilation peak in the spectra revealed the presence of N and P. A strong ^{28}Al photopeak at 1.78 MeV due to neutron activation was identified in four cadavers and verified according to its half-life (T/ sub 1/2/ = 2.30 min). The irradiation of the cadvers in the liver, lung, and skull always yielded the ^{28}Al photopeak. Any possibility of inducing ^{28}Al activity through (n,α) reaction of P was excluded. No Al contamination was found in the materials used to preserve the cadaver. The measured spectra with HP-Ge detector provided precision for N of about 2%, and for P 15%. Using NaI detector the precisions improved to 1% and 5% respectively. The quality of the deconvolution was evaluated using the low Chi- squares values, comparing the time integrals with the total number of counts in the peak, and inspection of the residual spectra. 12 refs., 3 figs., 2 tabs.

12405 **(ORNL/TM—10238) Nuclear medicine: Progress report for quarter ending June 30, 1986.** Knapp, F.F. Jr.; Ambrose, K.R.; Goodman, M.M.; Srivastava. P.C. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004039.

The development of a new method of protein radiolabeling involving the attachment of radioiodinated N-substituted maleimides to the sulfhydryl groups of proteins is described. Maleimides are known to form strong, sulfide bonds by reaction with organic thiols, and this method thus represents a new alternative to minimize the deiodination of radiolabeled proteins. As a model radioiodinating agent, N-(p[^{125}I]-iodophenyl)maleimide (IPM), was prepared by coupling p-iodoaniline with maleic anhydride, followed by subsequent ring closure. When administered to rats, the [I-125] IPM resulted in the retention of high levels of radioactivity in the blood pool. Further analysis demonstrated about 90% binding to red blood cells. It was also demonstrated that this agent effectively radiolabels model proteins such as BSA and IgG. An evaluation of the relative lipid pool distribution in rat heart extracts after intravenous administration of the straight-chain 15-(p-iodophenyl)pentadecanoic acid and 3,3-dimethyl-branched terminal iodophenyl-substituted fatty acid analogues to normotensive and hypertensive rats has been evaluated. Six shipments of osmium-191 were made to the University of Liege, Belgium, for preparation of radionuclide generators for clinical use and two generators were supplied to the Massachusetts General Hospital for continuous infusion studies in animals. 7 refs., 3 figs., 4 tabs.

12406 **Completely implantable hyperthermia applicator with externalized temperature monitoring: Tests in conductive gel.** Doss, J.D.; McCabe, C.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Medical Physics;* **13**: No. 6, 876-881(Nov 1986). Contract W-7405-ENG-36.

Development is underway on a hyperthermia applicator intended for complete implantation and long-term use. Radio frequency energy is transmitted from an external antenna to a closely coupled subdermal antenna. This internal antenna is connected via a transmission line to deeply implanted electrodes. Changes in temperature at the electrodes result in a change in tissue resistivity which modifies the complex impedance seen at the external antenna terminals. This variation in antenna impedance (magnitude and/or phase angle) can, in principle, be utilized to indirectly monitor and regulate tissue temperature at the electrode location. Test results from conductive-gel tissue phantom experiments are presented.

12407 **Fiber optic immunoassay sensor development.** Hirschfeld, T.; Anderson, W.; Block, M.; Eckerson, D.; Glass, T. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 675 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—). Contract W-7405-ENG-48.

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

Immunoassay sensors using an antibody coated optical fiber inside a capillary, can produce analytical results with no sample preparation steps and no skill intensive operations in a short time, on a sample of serum or whole blood with no background interferences. Further improvements in the technology include: 1) Kinetic optimization of the system by optimizing the fiber and capillary diameter, diluting the surface antibody layer with an insert antibody (anti-turtle antibody), and locating the competitive tagged antigen either on the antibody or loosely bound on the capillary wall depending on the avidity of the reaction. 2) Optimizing the system by appropriate selection of the surface binding procedure for the reagents, selecting tagging agents based on the characteristics of the light source, and adjusting the tagging level. 3) The construction of a portable readout device based on a miniature optical bench epiillumination fluorescence system. This system uses an NA 0.50 lens to drive a silica fiber held in special clutch. It uses an optimized filter set to isolate the returning fluorescence and measure it in a specially designed silicon diode photometer. The system can detect down to picomolar concentrations of bound antigen and is thus essentially avidity limited.

12408 **Applications of holography to X-ray imaging.** Howells, M.; Iarocci, M.; Kenney, J.; Rarback, H.; Rosser, R.; Yun, W. (State Univ. of New York, Stony Brook). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **523**: 347-354(1985). Contract AC03-76SF00098.

In this paper the authors consider various applications of holographic techniques to the problem of soft x-ray imaging. Special attention is given to imaging biological material using x-rays in the wavelength range 24-45A. The authors describe some experi-

ments on formation and reconstruction of x-ray holograms and propose some ways in which holographic techniques might contribute to the difficult problem of fabricating optical elements for use in the soft x-ray region.

12409 **Association of ferredoxin-NADP$^+$ oxidoreductase with the chloroplast cytochrome b-f complex.** Clark, R.D.; Hawkesford, M.J.; Coughlan, S.J.; Bennett, J.; Hind, G. (Brookhaven National Lab., Upton, NY). *FEBS (Federation of European Biochemical Societies) Letters;* **174**: No. 1, 137-142(Aug 1984).

The 37-kDa non-heme component in spinach cytochrome b-f complex prepared from EDTA-washed thylakoids is shown to be ferredoxin-NADP$^+$ oxidoreductase (EC1.18.1.2) on the basis of immunoreactivity, amino acid analysis, and pattern of cleavage by cyanogen bromide. Strong binding of the reductase to the isolated cytochrome complex suggests this is an important site for its attachment to the thylakoid membrane in vivo.

12410 **Quality control and technical outcome of ISO-DALT two-dimensional electrophoresis in a clinical laboratory setting.** Daufeldt, J.A.; Harrison, H.H. (Argonne National Lab, IL). *Clinical Chemistry (Winston-Salem, North Carolina);* **30**: No. 12, 1972-1980(1984). Contract W-31-109-ENG-38.

In this paper, they present initial quality-control evaluations for a prototype clinical laboratory, recommendations for clinical and technical data record-keeping, and laboratory protocols designed to minimize operator-dependent analytical error in a multiuser environment. These evaluations and recommendations are based on qualitative and semiquantitative two-dimensional electrophoresis studies of the College of American Pathologists' Reference Preparation for Serum Proteins (RPSP). They include the schematic map of RPSP and manually derived estimates of analytical precision for within-run and run-to-run performance with the standard 18 x 18 cm ISO-DALT system.

12411 **Experimental results of the dichotomic sampling in circular ring positron emission tomograph.** Cho, Z.H.; Hilal, S.K.; Ra, J.B.; Hong, K.S.; Lee, H.S.; Bigler, R.E. (Korea Advanced Institute of Science, Seoul). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-20**: No. 3, 1892-1897(Jun 1983). (CONF-821011—). Contract AC02-77EV04268.

From IEEE nuclear science symposium; Washington, DC, USA (20 Oct 1982).

Experimental verification of the new dichotomic sampling scheme was attempted and applied to a circular ring PET system to improve the sampling thereby the overall system resolution and its performances. In the experiment, two different types of aperture collimators were adopted for high resolution (HR) and very high resolution (VHR) imaging. In HR mode, a resolution of 6.5 mm FWHM was obtained without appreciable degradation in overall sensitivity which represents a threefold resolution improvement over the original system. In phantom studies with HR mode a sensitivity of 4500 counts/sec/μCi/cc was obtained for a 20 cm diameter uniform phantom filled with water. VHR mode experiment was also conducted to observe the ultimate resolution capability of DICHOTOM-I system and resolution of 4.2 mm FWHM was obtained at the expense of sensitivity reduction by a factor of four from HR mode experiment. 11 figures, 2 tables.

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REFER ALSO TO CITATION(S) 10856, 11005, 11872, 12345, 12346, 12348, 12359, 12361, 12372, 12374, 12377, 12378, 12383, 12384, 12385, 12386, 12387, 12388, 12391, 12394, 12401

12412 **(DOE/ER/10637—T2) The role of membranes and transport in the salt tolerance of halobacteria.** Lanyi, J.K. (California Univ., Irvine (USA). Dept. of Physiology and Biophysics). [1986]. Contract AS03-80ER10637. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003012.

In halobacteria two light-driven membrane pumps have been investigated: bacteriorhodopsin, which extrudes protons from the cell, and halorhodopsin, a recently discovered translocator for sodium ions. Bacteriorhodopsin and halorhodopsin are retinal proteins, and upon illumination of these pigments, a series of photochemical intermediates are produced which relax within 10 to 20 msec, and in an unknown way are coupled to the vectorial uptake and release of protons or sodium ions, respectively. There is reason to believe that the main pathway of sodium transport is not halorhodopsin, however. Rapid sodium extrusion from halobacterial cells is via a sodium/proton antiporter, which, by exchanging sodium ions for protons across the membrane will utilize the energy of the proton gradient to drive sodium transport. As far as it is known, such exchange is a more widespread mechanism for sodium transport in procaryotes, but primary pumps for sodium do exist in mammalian cells, and have been suggested to operate in plants as well. 50 refs.

12413 **Isolation and characterization of new facultatively alkalophilic strains of Bacillus species.** Guffanti, A.A.; Finkelthal, O.; Hicks, D.B.; Falk, L.; Sidhu, A.; Garro, A.; Krulwich, T.A. (City Univ. of New York, New York). *Journal of Bacteriology;* **167**: No. 3, 766-773(Sep 1986).

Four facultatively alkalophilic isolates were purified from enrichment cultures initiated with lime-treated garden soil. Four isolates, OF1, OF3, OF4, and OF6, were obligately aerobic, spore-forming, gram-positive, motile rods which were capable of growth at both pH 7.5 and pH 10.5. In DNA-DNA hybridization studies show complete homology of OF4 with obligately alkalophilic Bacillus of OF4 firmus RAB. All four isolates maintained a cytoplasmic pH that was considerably lower than the external pH when the latter was 10.5. Although substantial transmembrane electrical potentials were observed, the total electrochemical proton gradient ($\Delta\mu$/sub H$^+$/) was low at pH 10.5 in all the strains. By contrast, $\Delta\mu$/sub H$^+$/ was substantial at pH 7.5 and at that pH was composed entirely of an electrical potential. All the isolates exhibited substantial rates of respiration. Neither respiration nor NADH oxidation by everted membrane vesicles was significantly stimulated by Na$^+$. Analyses of reduced versus oxidized difference spectra of membranes from OF4 showed that the total membrane cytochrome content was considerably higher in cells grown at pH 10.5 than at pH 7.5, with the levels of c- and a-type cytochromes exhibiting the largest pH-dependent differences. Initial examination of membrane protein profiles on gel electrophoresis also indicated a number of changes in pattern in each isolate, depending on the growth pH.

12414 **Direct acridine orange counting of bacteria preserved with acidified Lugol iodine.** Nishino, S.F. (Univ. of Georgia, Athens). *Applied and Environmental Microbiology;* **52**: No. 3, 602-604(Sep 1986). Contract AS09-76EV00639.

Acidified and nonacidified Lugol iodine solution was tested under several storage temperatures and at several times as a preservative for marine bacteria. Direct counts with acridine orange showed no significant difference between glutaraldehyde- and Lugol iodine solution-preserved samples under any storage temperature when samples were counted within 1 week of collection. Specimens in long-term (up to 6 months) storage required refrigeration and treatment with acidified Lugol iodine solution for adequate preservation. Lugol iodine solution-preserved bacteria appeared intact under scanning electron microscopy. Lugol iodine solution did not preserve chlorophyll autofluorescence in phytoplankton.

12415 **Macromolecular organization of F_1-ATPase isolated from Clostridium thermoaceticum as revealed by electron microscopy.** Mayer, F.; Ivey, D.M.; Ljungdahl, L.G. (Univ. of Georgia, Athens). *Journal of Bacteriology;* **166**: No. 3, 1128-1130(Jun 1986). Contract AS09-79ER10499.

Membrane vesicles and the F_1-Atpase from Clostridium thermoaceticum were examined by electron microscopy. F_1-ATPase particles projecting from the vesicles have a diameter of 10 to 12 nm. The F_1-ATPase has an$\alpha_3\beta_3\gamma\delta$ structure. The α and β subunits are most likely arranged in an alternating sequence around a central protein mass consisting of the γ and δ subunits.

12416 **Multiparameter light scattering for rapid virus identification.** Salzman, G.C.; Grace, W.K.; Gregg, C.T.; McGregor, D.M. (Los Alamos National Lab., Los Alamos, NY). pp 103-110 of Applications of circularly polarized radiation using synchrotron and ordinary sources. Allen, F.; Bustamante, C. New York, NY; Plenum Press (1985). (CONF-8405239—).

From Workshop on applicatons of circularly polarized synchrotron radiation; Albuquerque, NM, USA (18 May 1984).

This paper describes a photopolarimeter for making simultaneous angular distribution measurements of up to eight of the Mueller matrix elements from a suspension of virus particles. Calibration and a technique for the correction of artifacts is also presented. This measurement technique may have broad applications in cell biology in general and in virology in particular. It may be possible to use multiparameter light scattering to identify viruses directly from clinical specimens. Shown is a sch ematic of the multiparameter light scattering photopolarimeter and calibration.

12417 **Physiology of Azospirillum in relation to its utilization as inoculum for promoting growth of plants.** Okon, Y. (Hebrew Univ. of Jerusalem, Rehovot, Israel). pp 165-174 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

The physiological properties of Azospirillum which make azospirilla very attractive organisms for use in colonization of roots are outlined. Following plant inoculation, Azospirillum preferentially adsorbs and proliferates on and in roots. It adapts well to the complex rhizosphere environment, aided by the physiological properties outlined above. It promotes root development and mineral and water uptake by the root by mechanisms not yet described. As a result of Azospirillum inoculation, biological nitrogen fixation increases mainly after flowering, contributing small amounts of combined N to the plant and the soil. The improvement in root function results in faster accumulation of dry matter in the plant, and, in many instances, higher crop yield. Numerous field inoculation experiments with Azospirillum have led to yield increases. 45 references, 3 figures, 4 tables.

12418 **Physiological aspects of Frankia.** Benson, D.R.; Mazzucco, C.E.; Browning, T.J. (Univ. of Connecticut, Storrs). pp 175-182 of Nitrogen fixation and CO3″ metabolism: proceedings. Ludden, P.W.; Burris, J.E. (eds.). New York, NY; Elsevier Science Publishing Co., Inc. (1985). (CONF-8406343—).

From 14. Harry Steenbock symposium on nitrogen fixation and CO/sub 2/ metabolism; Madison, WI, USA (17 Jun 1984).

Although the authors understanding of Frankia metabolism has increased dramatically over the past 5 years, many central questions remain. For example, the location and regulation of nitrogenase and associated enzymes in the free-living and symbiotic microorganism remain to be determined. The interpretation of many early studies has been complicated by the lack of adequate control over growth medium or phase of growth. More recent information highlights the importance of working with healthy cultures in defined medium. In a sense, the authors knowledge of frankiae ecology (cross-inoculation groups, survival, infection process, strain variation) is at the level of rhizobia knowledge in the early 1930s. The authors knowledge of Frankia physiology on the other hand is increasing at a very rapid pace and will soon be on a par with that of Rhizobium mainly because most of the questions applied previously to rhizobia can now be applied to frankiae.

12419 **Immunogenicity of methanococcaceae and monoclonal antibody survey of their antigenic markers and relationships.** Macario, A.J.L.; de Macario, E.C. (NYSDH, Albany). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **42**: 865(1983). (CONF-8604222—). Contract AC02-81ER10880.

From 70. annual meeting of the Federation of American Society for Experimental Biology; St. Louis, MO, USA (13 Apr 1986).

Methanococcus vannielii and M. voltae are two known species of Methanococcaceae of which strains SB and PSv respectively, were studied. They are methanogenic bacteria (MB). These are heterogeneous and inhabit a variety of ecological niches including the human gut. Their role in health and disease and immunological properties need elucidation. Using antibody probes from rabbit antisera, 4 clusters of antigenically related MB were found. They differ in cell-wall composition, each having a typical constituent:pseudomurein, protein, glycoprotein and heteropolysaccharide. SB and PSv are remarkable; chemical analyses indicate that they have a cell-wall made only of protein. This makes SB and PSv unique targets for immunology in areas such as evolution, taxonomy and modulation of the immune system. Both were immunogenic in rabbits and mice and serologically related with each other but not with the rest of MB, or other bacteria. A panel of monoclonal antibodies against SB was generated; 47% reacted only with SB and 53% reacted also with PSv; none bound sugars or aminosugars. Multiple testing of all MB with these antibodies indicated that some of the determinants recognized by them are markers of species, while others are of higher taxa.

12420 **Immunochemical identification of three proteinic determinants on the archaebacterium Methanococcus vannielii by monoclonal antibodies.** de Macario, E.C.; Macario, A.J.L.; Magarinos, M.C. (NYSDH, Albany). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **42**: 2127(1983). (CONF-8604222—). Contract AC02-81ER10880.

From 70. annual meeting of the Federation of American Society for Experimental Biology; St. Louis, MO, USA (13 Apr 1986).

Archaebacteria evolved independently from Eubacteria and Eukaryotes and present unique biochemical features. One group, the methanogens, show a variety of cell-walls paralleling their own evolutionary diversity. Chemical analyses revealed proteins in the cell-wall of Methanococcacea but no murein or pseudomurein. Immunochemical studies were begun using a panel of monoclonal antibodies against M. vannielii SB and quantitative micro-immunoenzymatic methods developed for this purpose. Direct binding and inhibition-blocking assays using sugars and aminosugars also indicated absence of these residues in the SB's cell-wall. Three antibodies, however, recognized three different antigenic determinants involving amino acids: Lys, Phe and Thr (antibody 5A); Ser, Try and Tyr (antibody 5B); and Arg, Lys and Phe (antibody 5F). Each site was recognized by one antibody only, and vice versa. These results agree with those provided by well established chemical methods and support the notion that SB possesses a peculiar cell-wall with proteins only. The data also show the resolution power and reliability of monoclonal probes for structural analysis of the bacterial envelope.

12421 **Cell-wall immunochemistry of the archaebacterium Methanosarcina barkeri strain 227 probed with monoclonal antibodies.** Garberi, J.C.; Macario, A.J.L.; de Macario, E.C. (NYSDH, Albany). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **42**: 2127(1983). (CONF-8604222—). Contract AC02-81ER10880.

From 70. annual meeting of the Federation of American Society for Experimental Biology; St. Louis, MO, USA (13 Apr 1986).

The Methanosarcinaceae have a cell-wall containing heteropolysaccharides; their chemistry is not fully elucidated, which hampers their use in research and biotechnology. The authors studied the immunogenicity and surface antigenicity of most strains available and found them closely related in accord with molecular biologic data. To clarify the structure of superficial determinants and provide a molecular basis for understanding the phylogeny of these bacteria, their interaction with other microorganisms in the ecosystems they inhabit and effects on the immune system. They prepared monoclonal antibodies against strain 227. Different determinants were identified, each one recognized by one antibody only. An immunochemical survey with antibody 8A showed that its corresponding determinant is in the cell-wall facing to the outside, and as such it is expressed only in strain 227. Its antigenicity is not detectably affected by formalin fixation but is destroyed by heat (100°C; 15 min). The determinant-bearing structure is a large molecule (MW≧ 3 x 10^5 D) which is released into the fluid phase of stored bacteria and quickly obtained by methanol extraction. It is

soluble in saline, contains carbohydrates, no detectable protein, and double-bonded C compounds which chromatograph as the lecithin and lysolecithin standards. Purification of this molecule is now on sight using insolubilized 8A antibody.

5509 Pathology

REFER ALSO TO CITATION(S) 12318, 12518

12422 (INIS-BR—559, pp 161-163) **Analysis of RNA biosynthesis in tobacco cell infected by pimiento ring virus.** Silva, D.M.; Nogueira, N.L.; Lage, G. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Escola Superior de Agricultura de Lavras, Minas Gerais, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The results about the RNA biosynthesis of pimiento ring virus are analysed. The possible virus influence on the nucleolus, mitochondria and chloroplast of the cellular RNA is studied by electron microscopy radio-authogram. The presence of the virus in the cell seems to modify ^{3}H-uridine transport to hostess cell interior.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 12407, 13010

12423 (DOE/ER/13337—T1) **Use of membrane vesicles as a simplified system for studying auxin transport of auxin: Progress report.** Goldsmith, M.H.M. (Yale Univ., New Haven, CT (USA)). 1986. Contract FG02-85ER13337. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002943.

Indoleacetic acid (IAA), the auxin regulating growth, is transported polarly in plants. IAA stimulates a rapid increase in the rate of electrogenic proton secretion by the plasma membrane. This not only increases the magnitude of the pH and electrical gradients providing the driving force for polar auxin transport and uptake of sugars, amino acids and inorganic ions, but, by acidifying the cell wall, also leads to growth. We find that auxin uptake by membrane vesicles isolated from actively growing plant tissues exhibits some of the same properties as by cells: the accumulation depends on the pH gradient, is saturable and specific for auxin, and enhanced by herbicides that inhibit polar auxin transport. We are using accumulation of a radioactive weak acid to quantify the pH gradient and distribution of fluorescent cyanine dyes to monitor the membrane potential. The magnitude of IAA accumulation exceeds that predicted from the pH gradient, and in the absence of a pH gradient, a membrane potential fails to support any auxin accumulation, leading to the conclusion that the transmembrane potential is not a significant driving force for auxin accumulation in this system. Since increasing the external ionic strength decreases saturable auxin accumulation, we are investigating how modifying the surface potential of the vesicles affects the interaction of the amphipathic IAA molecules with the membranes and whether protein modifying reagents affect the saturability and stimulation by NPA. These studies should provide information on the location and function of the auxin binding site and may enable us to identify the solubilized protein. 5 refs.

12424 (INIS-BR—559, pp 103-113) **Effects of water stress on the photosynthetic assimilation and distribution of ^{14}C-photosynthate in maize (Zea mays L.) and bean (Phaseolus vulgaris L.).** Martinez y Huaman, C.A.; Cerri, C.C. (Universidad Nacional Agraria, Lima, Peru; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The relationship between photosynthesis and distribution of ^{14}C-photosinthate as affected by water stress was evaluated. Corn (Zea mays L.) during the grain filling period and bean (Phaseolus vulgaris L.) during flowering, representing a C-4 and a C-3 photosynthetic type, respectively, were studied.

12425 (INIS-BR—559, pp 125-131) **Foliar absorption of phosphorus by common bean. Effect of sources, urea and sucrose.** Boaretto, A.E.; Muraoka, T.; Rosa, J.P.P. (UNESP, Botucatu, Brazil. Faculdade de Ciencias Agronomicas; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; UNITAU, Taubate, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The effet of urea and/or sucrose on P uptake from H_3PO_4 and monoammonium phosphate by bean leaves. A solution containing 0.145% P and specific activity 10μ Ci/ml is sprayed early in the morning or late afternoon. Besides the treatment without urea and sucrose, these substances are added in two concentrations 0.66% N + sucrose, and 1.32% N + sucrose. Twenty four hous after application, 52% of the applied P is absorved by the bean trifoliate leaf.

12426 (INIS-BR—559, pp 159-160) **Hydrogen uptake by Azolla-Anabaena. Behaviour of dependent-ATP and uptake hydrogenase in the Azolla-Anabaena System.** Ruschel, A.P.; Freitas, J.R. de; Silva, P.M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The hydrogen uptake in the Azolla-Anabaena system is studied. Tritium is used as tracer. Plants are incubated under different atmosphere composition: a) Air + $^3H_2$; b) Air + CO_2 + $^3H_2$ + CO; c) Air + $^3H_2$ + CO; d) Air + CO_2 + $^3H_2$ + CO to study the pathway of absorbed hydrogen in the Azolla-Anabaena system. Azolla-Anabaena showed greater hydrogen uptake under argonium atmosphere than under air. Carbon monoxide decreased hydrogen uptake. There are evidences of recycling of the hydrogen evolved through nitrogenease.

12427 (INIS-BR—559, pp 247-255) **Evapotranspiration of a corn crop (Zea mays, L.).** Calcache, M.; Engel, G. (Comision Ecuatoriana de Energia Atomica, Quito; Universidad Central del Ecuador, Quito. Facultad de Ciencias Agricolas). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The real and potential evapotranspiration of corn crop is calculated in a field experiment. The potential evapotranspiration (PET) is estimated using the Penman Method with a Type 'A' evaporation tank. The real evapotranspiration (RET) is measured using the Mass Balance Method based on periodic calculations of the volumetric moisture of the soil using a neutron probe and the matrix potential using tensiometers.

12428 **Inhibitor studies of dissimilative Fe(III) reduction by Pseudomonas sp. strain 200 (Pseudomonas ferrireductans).** Arnold, R.G.; DiChristina, T.J.; Hoffman, M.R. (California Institute of Technology, Pasadena). *Applied and Environmental Microbiology;* **52**: No. 2, 281-289(Aug 1986). Contract AS03-83ER13125.

Aerobic respiration and dissimilative iron reduction were studied in pure, batch cultures of Pseudomonas sp. strain 200 (Pseudomonas ferrireductans). Specific respiratory inhibitors were used to identify elements of electron transport chains involved in the reduction of molecular oxygen and Fe(III). When cells were grown at a high oxygen concentration, dissimilative iron reduction occurred via an abbreviated electron transport chain. The induction of alternative respiratory pathways resulted from growth at low oxygen tension (<0.01 atm [1 atm = 101.29 kPa]). Induced cells were capable of O_2 utilization at moderately increased rates; dissimilative iron reduction was accelerated by a factor of 6 to 8. In cells grown at low oxygen tension, dissimilative iron reduction appeared to be uncoupled from oxidative phosphorylation. Models of induced and uninduced electron transport chains, including a mathematical treatment of chemical inhibition within the uninduced, aerobic electron transport system, are presented. In uninduced cells re-

spiring anaerobically, electron transport was limited by ferrireductase activity. This limitation may disappear among induced cells.

12429 **Optrodes for in-vivo real time monitoring of /sub p/O/sub 2/ and /sub p/CO/sub 2/ in blood.** Miller, H.H.; Hirschfeld, T.; Miller, F. (Chemistry & Materials Science Dept., Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 674 of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Abstracts. Pittsburgh, PA; Pittsburgh Conference (1986). (CONF-860309—). Contract W-7405-ENG-48.

From 37. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (10 Mar 1986).

Fiber optic sensors have been developed to measure and monitor the partial pressures of oxygen and carbon dioxide in blood via fluorescence or phosphorescence changes in sensing dyes. The CO/sub 2/ optrode uses a nanoliter size droplet of concentrated fluorescein in a buffered sodium ascorbate solution as a pH indicator. The pH of the droplet equilibrates with the volatile constituents of blood across an air bubble trapped in a capillary surrounding the fiber. The droplet is contained in a rod of passivated porous glass bound to the tip of the fiber. The ascorbic acid reduces photobleaching, which is further reduced by working on the right portion of the concentration quenching curve. Signal levels of 300,000 counts per second are obtained at 0.5 microwatt excitation power. The response of the sensor are obtained at 0.5 microwatt excitation power. The response of the sensor has been evaluated from 1.97% to 7.40% CO/sub 2/ in air at controlled humidity and temperature, giving a 61% response range under dry and humid conditions. The O/sub 2/ optrode operates by phosphorescence quenching. A polynuclear aromatic fluorescer, adsorbed on controlled pore glass on the optical fiber tip, is again contained in a trapped bubble inside a capillary. The room temperature phosphorescence of the dye is quenched by oxygen (but does not respond to halogen containing anesthetics). Signal levels of 60,000 counts per second are obtained at 1.0 microwatt excitation power, and shows a 20% response over the physiological pO/sub 2/ range. These blood gas sensors have been successfully tested in the laboratory under controlled atmospheres, as well as in animals.

5520 Public Health

REFER ALSO TO CITATION(S) 10731, 12250, 12251, 12252, 12253, 12254, 12255, 12256, 12257, 12258, 12259

12430 **(PB—87-108338/XAB) Self-evaluation of occupational safety and health programs.** Hatch, L.L.; Rentos, P.G.; Godbey, F.W.; Schrems, E.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Technical Services). Oct 1978. 119p. (DHEW/PUB/NIOSH—78-187). NTIS, PC A06/MF A01.

Library of Congress catalog card no. 78-600123.

A self-evaluation procedure was developed for managers and labor personnel to use for the identification and prevention or control of various potential hazards in the work environment. According to the authors, most industries should benefit from the core of basic information provided. Employee-centered programs include the setting of specific goals and objectives with program elements designed to meet goals, staffing the program, employee involvement, and budgeting. Recognizing and controlling hazards requires adequate recordkeeping, inspections, priority setting, and employee incentives. Matching employees with job selection and training can be achieved through preplacement examinations, medical followup and surveillance, ergonomic studies, attention to alcohol and drug abuse, and the proper use of supervisory personnel. Effectiveness of a program can be measured through objective and subjective measurements and an assessment of relative risk factors.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 12286, 12289, 12305, 12363, 12369, 12370, 12393, 12422, 12427, 12477, 12521

12431 (INIS-BR—559, pp 133-136) **Use of nuclear techniques in agriculture in Venezuela.** Ramirez C, R. (Consejo Nacional para el Desarrollo de la Industria Nuclear, Caracas, Venezuela). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The agricultural activites being carried out so far in Venezuela are described. Failures and lessons learned from the induced mutation programme (sorghum and ajonjoli) are emphasized. Some of the results obtained with the use of isotopes in biological investigations with dairy and beef cattle and sheep are related.

12432 (INIS-BR—559, pp 167-171) **Fate of nitrogenous fertilizers in forest soil.** Pang, P.C.K. (Environment Canada, Pacific Forest Research Centre, Canada). 1984. NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The fate of the nitrogenous fertilizers through the processes of denitrification, ammonia volatilization, immobilization and uptake by a conifer is determined, with the aid of ^{15}N-labelled fertizers. The foliage of Douglas-fir was able to absorb gaseous ammonia under optimal conditions. Denitrification and immobilization of fertilizer-N by forest soil were highest with forest floor samples and decreased with depth. Laboratory studies with four-year-old Douglas-fir demostrated that a higher quantity of fertilizer-N was utilized by trees when the nitrogen was supplied as NO_3^- rather than NH_4^+.

12433 (INIS-BR—559, pp 173-181) **Use of fertilizer nitrogen by wheat in semiarid region of the Pampa, Argentina.** Lazzari, M.A.; Laurent, G.C. (Laboratorio de Humus, Departamento de Agronomia, U.N.S., Bahia Blanca, Argentina). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The efficiency of nitrogen utilization by wheat (Buck Pucara cultivar) in semiarid region of the Argentina Pampas is studied. A single-treatment-fertility-experiment is used, and in this method all treatments, as far as the plant, soil or environment are concerned, are identical. The only difference is the occurrence of the ^{15}N label within a given subtreatment.

12434 (INIS-BR—559, pp 183-194) **Fate of ^{15}N-urea and ^{15}N-ammonium sulphate applied in different periods to Cica-8 rice culture in greenhouse conditions.** Bastidas, O.G.; Alvarez, A.; Victoria, R.L.; Urquiaga C, S.; Muraoka, T. (Instituto de Asuntos Nucleares, Bogota, Colombia; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The fate of nitrogen fertilizers in rice cultivars (Cica-8) is studied. Urea (1.973% at of ^{15}N) and ammonium sulfate (1.826% at of ^{15}N) are used. The fertilizers are applied in four levels (0,100,200 and 300 Kg N/ha) in shadow conditions and after 30 days of germination.

12435 (INIS-BR—559, pp 195-203) **^{14}C-carbaril metabolism in soils modified by organic matter oxidation and addition of glucose.** Hirata, R.; Ruegg, E.F. (Instituto Biologico, Sao Paulo, Brazil. Centro de Radioisotopos). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Carbaril behaviour is studied in samples of Brunizen and Dark Red Latosol soils from Parana, using radiometric techniques, with the objective of determining the role of oxidation fo its organic components, and enrichment with glucose, in the metabolism of the insecticide. Lots of autoclaved soils, oxidized and with no previous treatment, with and without glucose addition, are incubated with ^{14}C-carbaril and analysed during eight weeks. Its was noted that, as a result of oxidation both soils showed a marked improvement in the metabolism of the agrochemical while addition of glucose exerted litlle influence on the degrading processes. Three metabolites were detected with R sub(f) 0.23, 0.40 and 0.70.

12436 (INIS-BR—559, pp 205-209) **Utilization of ^{15}N-urea by ratoon sugar-cane in the coastal plains of Pernambuco, Brazil.** Salcedo, I.H.; Sampaio, E.V.S.B. (Pernambuco Univ., Recife, Brazil. Dept. de Energia Nuclear). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

A field experiment is established at Goiana-PE, Brazil, on a Red-yellow Podzolic soil. Treatments, replicated four times, were: 1) no nitrogen; 2) 60Kg/ha of N at planting time and after plant crop harvest; and 3) 20Kg/ha of N at planting ad after plant crop harvest plus 40Kg/ha of N three months after each of these applications.

12437 (INIS-BR—559, pp 211-216) **Effects of urea foliar application and of ammonium sulphate and urea applied to the soil on yield and N utilization by beans (Phaseolus vulgaris L.).** Muraoka, T.; Victoria, R.L.; Oliveira, J.P.; Boaretto, A.E. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Empresa Brasileira de Pesquisa Agropecuaria, Goiania. Centro Nacional de Pesquisa de Arroz - Feijao; UNESP, Botucatu, Brazil. Faculdade de Ciencias Agronomicas). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The effects of nitrogen applied to the soil (as ammonium sulphate and urea) and foliar application of urea supplementing or not the soil application, on bean yield and nitrogen utilization are studied in a cerrado soil. Labelled ammonium sulphate is applied at the rate of 20Kg N/ha at seeding or 15 or 25 days after seeding and 40 Kg N/ha at seeding or in two different applications. Labelled urea is applied at the rate of 20kg N/ha at seeding and 40 Kg N/ha splitted. Foliar application is done at 15,22, 29,36 and 45 days after seeding, with 2% urea solution labelled with 10% ^{15}N.

12438 (INIS-BR—559, pp 239-246) **Evaluation of soil water and plant nitrogen status by nuclear techniques.** Reichardt, K.; Kirda, C.; Zapata, F.; Hardarson, G.; Axmann, H. (International Atomic Energy Agency, Vienna, Austria). 1984. NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Methodologies used to estimate soil water and nitrogen status of crops in field experiments are studied. Sampling procedures in a pasture experiment, consisting of three soil transects of 1.8 x 96m, one bare, one cropped to rye grass and one to alfalfa, are discussed. Data are analysed with respect to soil water contents measured through the use of neutron probes, N fertilizer uptake using ^{15}N labelled fertilizer and N_2 fixation, also using isotopic methodology.

12439 (INIS-BR—559, pp 115-118) **Systemic translocation and metabolism of ^{14}C-metalaxyl in citrus.** Musumeci, M.R.; Ruegg, E.F. (Instituto Biologico, Sao Paulo, Brazil. Centro de Radioisotopos). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Systemic uptake and translocation of ^{14}C-metalaxyl to citrus seedlings from soils (Humic Gley and Yellow Red Latosol) with different physical - chemical properties are studied. Seedlings of Citrus limonia are treated with ^{14}C-metalaxyl.

12440 (INIS-BR—559, pp 139-147) **Irradiation of foodstuffs. Possibilities and applications in agriculture.** Langerak, D.Is. (State Institute for Quality Control of Agricultural Products, Wagenibgen, the Netherlands). 1984. NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The use of ionizing radiation on the foodstuff preservation, as the possibilities and restrictions of the method are discussed. The produced effects (micro-biological, physiological, physical) are described. The radurization application in agriculture is studied.

12441 **(INIS-BR—567) Proceedings of the Regional Workshop on Nuclear Techniques in Crop Production - Abstracts.** (Sao Paulo Univ. (Brazil); Centro de Energia Nuclear na Agricultura, Piracicaba (Brazil)). 1984. 103p. (In Portuguese). (CONF-8411283—Absts.). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442.

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Scientific studies are presented on the following subjects: plant breeding and radiogenetics, plant nutrition and biochemistry, food irradiation, entomology, soil microbrology, soil fertility and fertilizers and soil physics.

12442 (INIS-BR—567, pp 42-43) **Residual effect on sugar cane ratoon of urea nitrogen foliar application to plant cane.** Trivelin, P.C.O.; Lara Cabezas, W.A.R.; Coleti, J.T. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Usina Sao Jose de Macatuba, Sao Paulo, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12443 (INIS-BR—567, pp 44-45) **Foliar absorption of phosphorus by common bean. Effect of sources, urea and sucrose.** Boaretto, A.E.; Muraoka, T.; Rosa, J.P.P. (UNESP, Botucatu, Brazil. Faculdade de Ciencias Agronomicas; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; UNITAU, Taubate, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12444 (INIS-BR—567, pp 46) **Use of nuclear techniques in agriculture in Venezuela.** Ramirez C, R. (Consejo Nacional para el Desarrollo de la Industria Nuclear, Caracas, Venezuela). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12445 (INIS-BR—567, pp 77-78) **Establishment and development of mycorrhizal infection and biological N_2 fixation in a bean crop with ^{15}N-mineral nitrogen.** Portugal, E.P.; Peron, S.C.; Saito, S.M.T.; Victoria, R.L. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12446 (INIS-BR—567, pp 84-85) **Use of fertilizer nitrogen by wheat in semiarid region of the Pampa, Argentina.** Lazzari, M.A.; Laurent, G.C.; Victoria, R.L. (Laboratorio de Humus, Departamento de Agronomia, U.N.S., Bahia Blanca, Argentina; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12447 (INIS-BR—567, pp 86-87) **Fate of ^{15}N-urea and ^{15}N-ammonium sulphate applied in different periods to Cica-8 rice culture in greenhouse conditions.** Bastidas, O.G.; Alvarez, A.; Victoria, R.L.; Urquiaga C, S. (Instituto de Asuntos Nucleares, Bogota, Colombia; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12448 (INIS-BR—567, pp 88) **^{14}C-carbaril metabolism in soils modified by organic matter oxidation and addition of glucose.** Hirata, R.; Ruegg, E.F. (Instituto Biologico, Sao Paulo, Brazil. Centro de Radioisotopos). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12449 (INIS-BR—567, pp 89-90) **Utilization of ^{15}N-urea by ratoon sugar-cane in the coastal plains of Pernambuco, Brazil.** Salcedo, I.H.; Sampaio, E.V.S.B. (Pernambuco Univ., Recife, Brazil. Dept. de Energia Nuclear). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12450 (INIS-BR—567, pp 91-92) **Study of loss due to volatilization of ^{15}N-urea and ^{15}N-ammonium sulphate in a calcic entisol of the central part of the Peruvian coast.** Urquiaga C, S.; Chavez N, J.; Victoria, R.L.; Bruiton, F. (Universidad Nacional Agraria, Lima, Peru; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Centro Internacional de La Papa, Lima, Peru). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12451 (INIS-BR—567, pp 93-94) **Effects of urea foliar application and of ammonium sulphate and urea applied to the soil on yield and N utilization by beans (Phaseolus vulgaris L.).** Muraoka, T.; Victoria, R.L.; Oliveira, J.P.; Boaretto, A.E. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Empresa Brasileira de Pesquisa Agropecuaria, Goiania. Centro Nacional de Pesquisa de Arroz - Feijao; UNESP, Botucatu, Brazil. Faculdade de Ciencias Agronomicas). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12452 (INIS-BR—567, pp 95) **Isotopically exchangeable phosphorus. Critique revision.** Barbaro, N.O. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12453 (INIS-BR—567, pp 96) **Isotopically exchangeable phosphorus as a correction value to adsorption isotherms. Agriculturist applications.** Lopez, S.C.; Barbaro, N.O.; Rojas de Tramontini, S.L.; Martini, O. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12454 (INIS-BR—567, pp 97) **Evaluation of soil water and plant nitrogen status by nuclear techniques.** Reichardt, K.; Kirda, C.; Zapata, F.; Hardarson, G.; Axmann, H. (International Atomic Energy Agency, Vienna, Austria). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12455 (INIS-BR—567, pp 98) **Evapotranspiration of a corn crop (Zea Mays, L.).** Calvache, M.; Engel, G. (Comision Ecuatoriana de Energia Atomica, Quito; Universidad Central del Ecuador, Quito Facultad de Ciencias Agricolas). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12456 (INIS-BR—567, pp 41) **Systemic translocation and metabolism of ^{14}C-metalaxyl in citrus.** Musumeci, M.R.; Ruegg, E.F. (Instituto Biologico, Sao Paulo, Brazil. Centro de Radioisotopos). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12457 (INIS-BR—567, pp 49) **Possibility of using gamma irradiation in the preservation of 'mangara' Xanthosoma mafafa (Schott.).** Wiendl, F.M.; Vasconcellos, E.F.C. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Sao Paulo Univ., Piracicaba, Brazil. Escola Superior de Agricultura Luiz de Queiroz). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12458 (INIS-BR—567, pp 50) **Utilization of gamma radiation to preserve hydrated fresh macaroni.** Baracat, M.L.A.; Wiendl, F.M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12459 (INIS-BR—567, pp 51-52) **Preservation of potatoes by ^{60}Co gamma radiation.** Bleinroth, E.W.; Mori, E.E.M.; Wiendl, F.M. (Instituto de Tecnologia de Alimentos, Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12460 (INIS-BR—567, pp 53-54) **Preservation of onions (Allium cepa L.) using 60-cobalt gamma radiation.** Wiendl, F.M.; Bleinroth, E.W. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Instituto de Tecnologia de Alimentos, Campinas, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12461 (INIS-BR—567, pp 55-56) **Preservation of mangos cultivar 'Haden' using ^{60}Co gamma radiation.** Bleinroth, E.W.; Wiendl, F.M. (Instituto de Tecnologia de Alimentos, Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12462 (INIS-BR—567, pp 57) **Increase in 'champignon', Agaricus sp shelf-life using gamma radiation.** Nemoto, S.H.; Wiendl, F.M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12463 (TVA/OACD—86/12) **Fertilizer trends: Production, consumption, and trade.** Bridges, J.D. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). Oct 1986. 51p. NTIS, PC A04/MF A01. File Number DE87900348.

By the end of crop year 1983, fertilizer use dropped 23% from the 1981 record of 54 million tons. In 1983, fertilizer use fell to 41.8 million tons. In 1984, fertilizer use turned upward. The resulting optimism, however, was short-lived. Following an 8-million-ton recovery, fertilizer use once again fell a million tons in 1985. The fertilizer industry faced the spring of 1986 with excess supplies. Preliminary estimates for the 1986 crop year, point to another significant decrease in fertilizer use. Instability of the domestic and export markets has caused serious trouble for the US fertilizer industry. Production capacities for all leading nitrogen products and potash have been reduced since the late 70's and early 80's. Because of increasing export demand for phosphates, capacities for the leading phosphate materials increased until 1985. However, operating rates have varied because of inconsistency in export demand.

12464 (TVA/PUB—87/3) **Estimating fertilizer application costs.** Simpson, G.S.; Williams, R.J. (National Fertilizer Development Center, Muscle Shoals, AL (USA)). Jan 1985. 15p. NTIS, PC A02/MF A01. File Number DE87900349.

Application costs vary greatly depending upon the type of fertilizer applied, the method of application, and the annual acreage over which fertilizer is applied. A common "market area" application charge does not reflect a common "cost" of applying fertilizer by dealers or custom applicators, nor does it always reflect the least-cost method to the farmer for applying fertilizer. It may reflect the price farmers are willing to apy for this service. Budgeting can be used by fertilizer dealers, custom applicators, and farmers to estimate the cost of applying fertilizer. The budget presented here is simple to set up and use and will provide either rough or close estimates. Accuracy of this or any budget depends upon the fixed and variable cost items included, how these items are calculated, and the accuracy of the cost inputs. The fixed and variable cost items included in the example are relatively complete, but other costs specific to a particular operation should be included. Also, there are many ways to compute such costs as depreciation and interest. Finally, cost coefficients or assumptions used to estimate these coefficients will greatly affect accuracy of the entire budget.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 12194

5601 Radiation Effects

REFER ALSO TO CITATION(S) 12695

12465 (AD-A—172793/2/XAB) **Thymic hormones in thymus recovery from radiation injury.** Neta; Schwartz, G.N.; MacVittie, T.J.; Douches, S.D. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1985. 8p. (AFRRI-SR—86-29). NTIS, PC A02/MF A01.

The effect of a thymic hormone, thymosin fraction 5 (TF5), in restoring immunocompetence in the thymus of gamma-irradiated mice was examined. Three different mouse strains were used in this study, since previous work has established that the response to TF5 varies in different strains. To measure the rate of recovery of immunocompetent cells in the thymus, the responsiveness to comitogenic effect of interleukn-1 (IL-1) was used. This assay was chosen since it has been established that only more mature PNA, Lytl(+2-) medullary cells respond to this monokine. Contrary to several earlier reports that radio-resistant cells repopulating the thymus within the first 10 days after irradiation are mature, corticosteriod-resistant, immunocompetent cells, the thymic cells from irradiated mice in all strains used had greatly reduced responses to IL-1. Daily intraperitoneal injections of TF5 increased significantly the responses of thymic cells to IL-1 in 10-13 weeks old C57B1/KsJ, C3H/HeJ, and DBA/1 mice. Older mice, 5 months or more in age, of DBA/1 strain did not respond to treatment with TF5. However, C3H/HeJ mice of the same age were highly responsive. In conclusion, (a) cells repopulating the thymus within 12 days after irradiation contain lower than normal fraction of mature IL-1 responsive cells, (b) thymic hormones increase the rate of recovery of immunocompetent cells in the thymus, and (c) the effect of thymic hormones is strain and age dependent.

12466 (AD-A—172795/7/XAB) **Effect of gamma radiation on sodium channels in different conformations in neuroblastoma cells.** Freschi, J.E.; Moran. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 7p. (AFRRI-SR—86-26). NTIS, PC A02/MF A01.

The dose-response relationship between gamma radiation and batrachotoxin-stimulated sodium influx in neuroblastoma cells in tissue culture was studied. Also tested was the hypothesis that changes in sodium-channel conformation may alter the radiosensitivity of the channel. It was found that gamma radiation inhibited toxin-stimulated ^{22}Na uptake at doses beyond a threshold of 200-300 Gy. No effects were seen following doses below 100 Gy. This inhibition of sodium permeability was seen when the cells were irradiated with sodium channels in the closed or inactivated, nonconducting states. However, when the channels were in the toxin-opened, conducting state, gamma radiation had no effect at doses up to 2000 Gy. Results support earlier electrophysiological studies that showed that high doses of ionizing radiation are required to produce a measureable decrease in sodium permeability. In addition, the data suggest that by changing the sodium-channel conformation, batrachotoxin appears to alter radiosensitive chemical bonds in the gating or ion-conducting portion of the channel.

12467 (AD-A—172796/5/XAB) **Heart-function studies in dogs after acute gamma irradiation of the precordium.** Durakovic. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). May 1986. 3p. (AFRRI-SR—86-24). NTIS, PC A02/MF A01.

In order to study the development of post-irradiation cardiac dysfunction, we irradiated the precordia of 18 adult beagle dogs were irradiated with 30, 60, or 100 Gy of Co-60 photons, and cardiac histology, electrocardiograms, Tc-99, pyrophosphate cardiac tissue distribution, and serial left ventricular ejection fraction (LVEF) were measured. Although the electrocardiograms and tissue distribution of Tc-99m were unaffected by these dose levels, the LVEF was reduced by day 58 for all the irradiated dogs. The

delay in the onset of cardiac-function impairment parallels the delay in the onset of fibrosis in irradiated hearts.

12468 **(BNL—52030) Workshop on short-term health effects of reactor accidents: Chernobyl.** (Brookhaven National Lab., Upton, NY (USA)). 8 Aug 1986. Contract AC02-76CH00016. 46p. (CONF-8608113—Summs.). NTIS, PC A03/MF A01; GPO Dep. File Number DE87003078.

From Short-term effects of reactor accidents: Chernobyl; Upton, NY, USA (8 Aug 1986).

The high-dose early-effects research that has been continued has been done in the context of infrequent accidents with large radiation sources and the use of bone marrow transfusions for treating malignancies, especially leukemia. It thus seemed appropriate to bring together those who have done research on and have had experience with massive whole-body radiation. The objectives were to review what is known about the acute effects of whole-body irradiation, to review the current knowledge of therapy, and particularly of the diagnostic and immunologic problems encountered in bone marrow therapy, and to compare this knowledge with observations made to date on the Chernobyl accident radiation casualties. Dr. Robert Gale, who had helped to care for these casualties, was present at the Workshop. It was hoped that such a review would help those making continuing clinical and pathological observations on the Chernobyl casualties, and that these observations would provide a basis for recommendations for additional research that might result in improved ability to manage successfully this type of severe injury.

12469 **(DOE/CH/10288—3) [Radiation induced changes in the cuticular hydrocarbons of the granary weevil and their relationship to dessication and adult mortality]: Quarterly report, August 15 to November 14, 1986.** (Selma Univ., AL (USA). Div. of Natural and Applied Sciences). 1986. Contract FG02-86CH10288. 11p. NTIS, PC A02. File Number DE87003683.

These studies elucidate the effective dose range for survival/life span of the weevil to select the age group and dose level required for studies on epicuticular hydrocarbon profiles. The analysis of "hydrocarbons" revealed the presence of seven fatty acids. The fatty acids ranged from C14:0 to C20:0. It was seen that when weevils were irradiated with doses 0.15 to 0.5 kgy, these were differences in quantity of the fatty acids, particularly the fatty acids C16:0, C18:2, C18:1 and C20:0. 2 figs., 3 tabs.

12470 **(DOE/EH—0026) Handbook for the Department of Energy Laboratory Accreditation Program for personnel dosimetry systems.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC). Dec 1986. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003695.

The program contained in this Handbook provides a significant advance in the field of radiation protection through a structured means for assuring the quality of personnel dosimetry performance. Since personnel dosimetry performance is directly related to the assurance of worker safety, it has been of key interest to the Department of Energy. Studies conducted over the past three decades have clearly demonstrated a need for personnel dosimetry performance criteria, related testing programs, and improvements in dosimetry technology. In responding to these needs, the DOE Office of Nuclear Safety (EH) has developed and initiated a DOE Laboratory Accreditation Program (DOELAP) which is intended to improve the quality of personnel dosimetry through (1) performance testing, (2) dosimetry and calibration intercomparisons, and (3) applied research. In the interest of improving dosimetry technology, the DOE Laboratory Accreditation Program (DOELAP) is also designed to encourage cooperation and technical interchange between DOE laboratories. Dosimetry intercomparison programs have been scheduled which include the use of transport standard instruments, transport standard radioactive sources and special dosimeters. The dosimeters used in the intercomparison program are designed to obtain optimum data on the comparison of dosimetry calibration methodologies and capabilities. This data is used in part to develop enhanced calibration protocols. In the interest of overall calibration update, assistance and guidance for the calibration of personnel dosimeters is available through the DOELAP support laboratories. 20 refs., 1 tab.

12471 **(DOE/EH—0027) Department of Energy standard for the performance testing of personnel dosimetry systems.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC). Dec 1986. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003696.

This standard is intended to be used in the Department of Energy Laboratory Accreditation Program (DOELAP) for personnel dosimetry systems. It is based on the American National Standards Institute's (ANSI) "Criteria for Testing Personnel Dosimetry Performance," ANSI N13.11-1983, recommendations made to DOE in "Guidelines for the Calibration of Personnel Dosimeters," Pacific Northwest Laboratory (PNL)-4515 and comments received during peer review by DOE and DOE contractor personnel. The recommendations contained in PNL-4515 were based on an evaluation of ANSI N13.11 conducted for the Office of Nuclear Safety, DOE, by PNL. Parts of ANSI N13.11 that did not require modification were used essentially intact in this standard to maintain consistency with nationally recognized standards. Modifications to this standard have resulted from several DOE/DOE contractor reviews and a pilot testing session. An initial peer review by selected DOE and DOE contractor representatives on technical content was conducted in 1983. A review by DOE field offices, program offices, and contractors was conducted in mid-1984. A pilot performance testing session sponsored by the Office of Nuclear Safety was conducted in early 1985 by the Radiological and Environmental Sciences Laboratory, Idaho Falls. Results of the pilot test were reviewed in late 1985 by a DOE and DOE contractor committee. 11 refs., 4 tabs.

12472 **(DOE/ER/60464—1) Direct assays of radiation induced DNA base lesions in mammalian cells: Technical progress report.** Wheeler, K.T. (Bowman Gray School of Medicine, Winston-Salem, NC (USA). Dept. of Radiology). 1986. Contract AC02-84ER60196;FG05-86ER60464. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003919.

HPLC techniques were used to separate, detect, identify and quantitate radiation-induced damage products of adenine (A)-containing model compounds and eukaryotic DNA. A library of 7 pure synthetic or isolated major damage products has been established consisting of 8-hydroxyadenine, 4,6 diamino-5-formamidopyrimidine, 8-hydroxy-2-deoxyadenosine, 8 hydroxy-2-deoxadenosine monophosphate, the R and S isomers of 8,5'-cyclo-2-deoxyadenosine monophosphate and α-deoxyadenosine. The structure and conformation may drastically alter the spectrum and quantity of lesions produced by ionizing radiation. This had been suggested by others on the basis of the results observed when the dinucleotides dApT and dTpA were irradiated in dilute solution. When poly (dA) and ds poly d(A-T) were irradiated under oxic conditions, the major damage product (8-OHdAdo) was the same, but the yield was different. When these compounds were irradiated under anoxic conditions, the cdAdo isomers were not the major damage products but rather α-dAdo was produced in quantities 10 to 100 times greater than the cdAdo isomers. 2 refs., 1 fig., 2 tabs.

12473 (INIS-BR—559, pp 3-12) **Alterations in biochemical and physiological characters in radiation-induced mutants of grain legumes.** Mueller, H.P. (Bonn Univ., Germany, F.R. Inst. fuer Genetik). 1984. NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Selected examples from different grain legumes are studied. The biochemically and physiologically detectable alterations in distinct characters as caused by the action of mutant genes are presented comparatively. The interactions between different mutant genes in order to evaluated the influence of the genotypic constitution on the expression of mutated genes are emphasized.

12474 (INIS-BR—559, pp 27-31) **Evaluation of gamma radiation (60-Co) induced mutation in two Phaseolus vulgaris varieties.** Silva, R.M.; Lopez, S.S.; Montepeque R, R. (San Carlos Univ. of Guatemala, Guatemala City; Direccion General de Energia Nuclear, Guatemala City, Guatemala). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Two varieties of Phaseolus vulgaris (Jutiapan and San Martin) were irradiated at 0, 8, 15, 20 and 30 kR doses in a 60-cobalt gamma source, to identify mutants and 20% lethality. M_3 plants showing morphogical mutations were selected. Differences in sensitivity to irradiation of the two varieties were noted, using data and physiological effects of M_1. Selection and analysis for protein content were in M_3 as well as hereditary changes.

12475 (INIS-BR—559, pp 37-40) **Effect of cobalt-60 gamma-ray irradiation on beans (Phaseolus vulgaris L.) of huasteco variety.** Navarro A, W. (Universidade Nacional, Faculdad Ciencias de la Tierra y el Mar, 'Campus Omar Dengo', Heredia, Costa Rica). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Bean seeds, Huasteco variety, were irradiated at 10, 20, 30 and 40 kR in a cobalt-60 gamma-ray source. Non-irradiated seeds were used as control. Irradiated and non-irradiated seeds were planted under greenhouse conditions using a random design and a population of 200 plants per treatment for both first and second generations (M_1 and M_2). The characters studied were; germination, survival, morphological changes of leaves and stem, change in seed coat colour, flowering, height, stem diameter, number of internodes, number of pods and number of seeds per pod. General plant behaviour was also observed to detect changes on a genic or chromosomic level.

12476 (INIS-BR—559, pp 91-100) **Effect of gamma irradiation (^{60}CO) on qualitative characters of barley (Hordeum vulgare).** Santana, T.C.; Gonzalez, F.C. (Centro de Genetica, Colegio de Postgraduados, Chapingo, Mexico). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Seeds of barley line were irradiated with doses ranging from O to 64 Kr of gamma radiation for three consecutive generations (R1,R2 and R3). From these, several mutant generations were obtained in the field, planting at a commercial density and without selection.

12477 (INIS-BR—559) **Proceedings of the Regional Workshop on Nuclear Techniques in Crop Production.** (Sao Paulo Univ. (Brazil); Centro de Energia Nuclear na Agricultura, Piracicaba (Brazil)). 1984. 275p. (In Portuguese). (CONF-8411283—). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441.

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Scientific studies are presented on the following subjects: plant breeding and radiogenetics, plant nutrition and biochemistry, food irradiation, entomology, soil microbiology, soil fertility and fertilizers and soil physics.

12478 (INIS-BR—559, pp 13-16) **Rubber tree resistance to Microcylus ulei through induced mutation. I. Determination of radiosensivity in rubber.** Menten, J.O.M.; Tulmann Neto, A.; Ando, A.; Cardoso, M.; Pinheiro, J. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Instituto Agronomico de Campinas, Brazil; Coordenadoria de Assistencia Tecnica Integral, Pederneiras, Brazil. Posto de Producao de Mudas). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

One meter branches with about 20 mature buds of clone RRIM 600 were treated with increasing doses of gamma radiation from a ^{60}Co source. About 100 buds were treated with O (control), 1, 2, 3 and 4 kR and grafted to stocks. The following parameters were evaluated: 'taking', height of sprouting and abnormalities (at different stages of the experiment). (M.A.C.).

12479 (INIS-BR—559, pp 17-25) **Radioinduced variation in genetic improvement of sorghum (Sorghum bicolor (L.). Moench).** Gutierrez del Rio, E. (Guanajuato Univ., Mexico). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

A genetic variability study among 25 varieties of sorghum (Sorghum bicolor (L.) Moench) is presented. The populations are irradiated with 0, 10, 20, 30, 40, 50 and 60 Krads of cobalt 60 as far as M_3 generation. An individual selection is done taking into consideration agronomic characteristics like precocity, type, size. height of the plant.

12480 (INIS-BR—559, pp 41-45) **Induction of mutation, through gamma rays, in sugarcane.** Vieira, M.A.S.; Matsuoka, S.; Ruschel, R.; Tulmann Neto, A.; Ando, A. (PLANALSUCAR, Araras, Brazil; Empresa Brasileira de Pesquisa Agropecuaria, Goiania. Centro Nacional de Pesquisa de Arroz - Feijao; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Variety buds Co-740 of sugar cane were irradiated with gamma rays ^{60}Co at 0.0, 3.0, 4.0, 5.0, 6.0 and 7.0 kR to study changes in the obtained progeny. Evaluation of the germination capacity, height of plants and morphological changes were studied in the different treatments. (M.A.C.).

12481 (INIS-BR—559, pp 47-49) **Research work to obtain pepper (Piper negrum L.) mutants resistant to Fusarium disease.** Ando, A.; Menten, J.O.M.; Tulmann Neto, A.; Albuquerque, F.C. de; Hirakata, K. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Empresa Brasileira de Pesquisa Agropecuaria, Belem. Centro de Pesquisa Agropecuaria do Tropico Umido; Instituto Experimental Agricola Tropical da Amazonia, Belem, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Cuttings of black pepper (Piper nigrum L.) variety Singapore were irradiated at different doses (from 3.0-7.0 kR) of gamma radiation in the ^{60}Co source. After two successive prunings of surviving M_1 plants (from the irradiated cuttings), hundreds of vM_3 cuttings were planted separately in pots and artificially inoculated with Fusarium solani f. piperi. The surviving vM_3 plantlets were transplanted to an experimental field highly infested with this pathogen. After two years in the infested field, only three UM_3 plants continue to grow.

12482 (INIS-BR—559, pp 51-54) **Mutation breeding for nutritional value in wheat.** Barriga, P.; Fuentes, R.; Manquian, N.; Mansilla, R. (Universidad Austral de Chile, Valdivia). 1984. (In Spanish). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

In 1981 two batches of 100,000 seeds of the spring wheat cultivars Austral and Huenufen were irradiated with gamma rays at 10 and 25 Krad doses. The source of radiation was ^{60}Co, from the Comision Chilena de Energia Nuclear. Objectives of this irradiation program were to develop wheat cultivars well adapted to the Lakes Region of Chile (latitude south 39 to 40°), whith higher content of protein and lysine and good yield. Generation M_1 was sown densily under field conditions and harvested by mass selection. Plant selection was set up in generation M_2 onwards. Selected mutants for protein content (DBC values) in generations M_2 (1982-1983) and M_3 (1983-1984) showed ranges from 18 to 22%. These contents were higher than in the controls. As regards lysine content of the proteins, the number of selected was low, however mutants with maximum lysine content overshot 4%. In M_4 generation, the better mutants, with adequate number of controls, will be analyzed in the crop season 1984-1985, in preliminary trials of production.

The technique of horizontal polyacrylamide gel electrophoresis as an alternative technique to the identification and certification of mutants with high content of protein is examined.

12483 (INIS-BR—559, pp 61-64) **Induced mutation aiming at resistance to anthracnosis in stylosanthes guianensis (Aubl) Sw. .** Jorge, E.M.P.O.; Alcantara, P.B.; Mecelis, N.R.; Ghisi, O.M.A.A.; Menten, J.O.M.; Tulmann Neto, A.; Ando, A. (Instituto de Zootecnia de Nova Odessa, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The material used was the introduction N.O. 1336, due to its good agronomic characteristics. Radiosensitivity determination was made by irradiation of dry seeds at various gamma-ray doses in the ^{60}Co source. Based on generation plant height and survival in relation to control, two doses were chosen for the definitive treatment around GR_{35} and LD_{50}. Seeds were irradiated at these doses and planted in the field. Harvesting was carried out by mass process.

12484 (INIS-BR—559, pp 65-78) **Radiosensitivity of quince seeds (Cydonia oblonga Mill.).** Dall'Orto, F.A.C.; Ojima, M.; Hiroce, R.; Igue, T.; Ferraz, E.S.B.; Nascimento Filho, V.F. do; Menten, J.O.M.; Tulmann Neto, A.; Ando, A. (Instituto Agronomico de Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The investigation with quince seeds (Cydonia oblonga Mill.) radiosensitivity and the mineral composition of the plants obtained for mutation breeding are related. The concentration of some macro and micronutrients in quince seedlings obtained from irradiated seeds are studied.

12485 (INIS-BR—559, pp 79-84) **Cytogenetics and radiosensitivity for quince tree breeding purpose (Cydonia oblonga Mill.).** Dall'Orto, F.A.C.; Barbosa, W.; Cruz, N.D.; Ferraz, E.S.B.; Menten, J.O.M.; Tulmann Neto, A.; Ando, A. (Instituto Agronomico de Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Quince cytogenetic aspects were studied to determine the level of ploidy and chromosome number, of Cydonia oblonga Mill. The existence or not of first genetic barriers which would hamper the intercross of the eight studied varieties (Acucar, Champion, Cheldow, Manning, Mato Dentro, Mendoza-INTA 37, Portugal and Smyrna) was done.

12486 (INIS-BR—559, pp 85-90) **Induced mutation in soybean (Glycine max L.) breeding.** Tulmann Neto, A.; Menten, J.O.M.; Ando, A. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The induced mutation in soybean (Glycine max, L.) breeding is studied. Seed treatment with gamma-rays or methanesulfonic acid ethyl ester (EMs) is used in the following varieties: Parana, Santa Rosa, UFV-1, Foscarin 31 and IAC-8. The study to obtain resistance to the soybean bud blight virus and mutants resistant to rust was done. Early mutants are also researched.

12487 (INIS-BR—559, pp 151-155) **Review and present status of the medfly program in Mexico.** Enkerlin S, D.; Liedo, P.; Ortiz, G.; Reys, J.; Schwarz, A. (Direccion de Sanidad Vegetal y Centro de Investigaciones Ecologicas del Sureste, Monterrey, Mexico; Direccion de Sanidad Vegetal, Secretaria de Agricultura y Recursos Hidraulicos, Mexico). 1984. NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

Different aspects of the Medfly Program in Mexico are discussed: the massrearing operation itself, the irradiation, packing and shipping of the sterile flies, quality control procedures, maintenance and food stocking, field operations such as release, trapping food sampling, insecticide applications and continuous research for improving the whole operation, food sampling, as well as a solid quarantine program and good working realtions with the public and with other countries.

12488 (INIS-BR—567, pp 1) **Alterations in biochemical and physiological characteres in radiation - induced mutants of grain legumes.** Mueller, H.P. (Bonn Univ., Germany, F.R. Inst. fuer Genetik). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12489 (INIS-BR—567, pp 6-7) **Evaluation of gamma radiation (60-Co) induced mutation in two Phaseolus vulgaris varieties.** Montepeque R, R. (Direccion General de Energia Nuclear, Guatemala City, Guatemala). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12490 (INIS-BR—567, pp 10-11) **Effect of cobalt-60 gamma-ray irradiation on beans (Phaseolus vulgaris L.) of huasteco variety.** Navarro A, W. (Universidad Nacional, Faculdad Ciencias de la Tierra ej el Mar, 'Campus Omar Dengo', Heredia, Costa Rica). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12491 (INIS-BR—567, pp 36) **Effect of gamma irradiation (^{60}Co) on quantitative characters of barley (Hordeum vulgare).** Santana, T.C.; Gonzalez, F.C. (Centro de Genetica, Colegio de Postgraduados, Chapingo, Mexico). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12492 (INIS-BR—567, pp 2-3) **Rubber tree resistance to Microcyclus ulei through induced mutation. I. Determination of radiosensivity in rubber.** Menten, J.O.M.; Tulmann Neto, A.; Ando, A.; Cardoso, M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Instituto Agronomico de Campinas, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12493 (INIS-BR—567, pp 4-5) **Radioinduced variation in genetic improvement of sorghum (Sorghum bicolor (L.). Moench).** Gutierrez del Rio, E. (Guanajuato Univ., Mexico). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12494 (INIS-BR—567, pp 12-13) **Induction of mutation, through gamma rays, in sugarcane.** Vieira, M.A.S.; Matsuoka, S.; Ruschel, R.; Tulmann Neto, A.; Ando, A. (PLANALSUCAR, Araras, Brazil; Empresa Brasileira de Pesquisa Agropecuaria, Goiania. Centro Nacional de Pesquisa de Arroz - Feijao; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12495 (INIS-BR—567, pp 14) **Induction of mutation in vine aiming resistance to mildew. Plasmopara viticola (Berk and Curtiss) Berl. et De Toni.** Ribeiro, I.J.A.; Terra, M.M.; Passo, I.R.S.; Tulmann Neto, A.; Menten, J.O.M.; Ando, A. (Instituto Agronomico de Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12496 (INIS-BR—567, pp 17-18) **Use of induced mutation in genetic breeding of wheat (Triticum aestivum L.) cultivars.** Philipovsky, J.F.; Tulmann Neto, A.; Menten, J.O.M.; Ando, A. (Instituto Agronomico do Parana, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12497 (INIS-BR—567, pp 19-20) **Mutation breeding for nutritional value in wheat.** Barriga, P.; Fuentes, R.; Manquian, N.; Mansilla, R. (Universidad Austral de Chile, Valdivia). 1984. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12498 (INIS-BR—567, pp 22-23) **Possibility of using induced mutation to obtain resistance to the mosaic virus in papaya, Carica papaya L. .** Tulmann Neto, A.; Menten, J.O.M.; Ando, A.; Soares, N.B.; Martins, A.L.M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Instituto Agronomico de Campinas, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12499 (INIS-BR—567, pp 26-27) **Induced mutation aiming at resistance to anthracnosis in Stylosanthes guianensis (Aubl) Sw .** Jorge, E.M.P.O.; Alcantara, P.B.; Mecelis, N.R.; Ghisi, O.M.A.A.; Menten, J.O.M.; Tulmann Neto, A.; Ando, A. (Instituto de Zootecnia de Nova Odessa, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12500 (INIS-BR—567, pp 28-31) **Radiosensitivity of quince seeds (Cydonia oblonga Mill.).** Dall'Orto, F.A.C.; Ojima, M.; Hiroce, R.; Igue, T.; Ferraz, E.S.B.; Nascimento Filho, V.F. do; Menten, J.O.M.; Tulmann Neto, A.; Ando, A. (Instituto Agronomico de Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12501 (INIS-BR—567, pp 32-33) **Cytogenetics and radiosensitivity for quince tree breeding purpose (Cydonia oblonga Mill.).** Dall'Orto, F.A.C.; Barbosa, W.; Cruz, N.D.; Ferraz, E.S.B.; Menten, J.O.M.; Tulmann Neto, A.; Ando, A. (Instituto Agronomico de Campinas, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12502 (INIS-BR—567, pp 34-35) **Induced mutation in soybean (Glycine max L.) breeding.** Tulmann Neto, A.; Menten, J.O.M.; Ando, A. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12503 (INIS-BR—567, pp 58-59) **Effect of increasing doses of gamma radiation from ^{60}Co on Chrysomya megacephala (Fabr.) with a view to the application of the sterile insect technique.** Garcia, C.R.; Wiendl, F.M. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12504 (INIS-BR—567, pp 60) **Determination of the gamma radiation sterilizing dose for adults of Sitophilus granarius (L., 1758) (Col., Curulionidae) in wheat.** Arthur, V. (Escola Superior de Agronomia de Paraguacu Paulista, Sao Paulo, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12505 (INIS-BR—567, pp 61-62) **Influence of ^{60}Co gamma radiation on longevity and induced sterility in imagos of Laemophloeus ferrugineus (Stephens, 1831) (Col. Cucujidae).** Lopes, L.A.; Wiendl, F.M.; Walder, J.M.M.; Arthur, V. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Escola Superior de Agronomia de Paraguacu Paulista, Sao Paulo, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12506 (INIS-BR—567, pp 65) **Review and present status of the medfly program in Mexico.** Enkerlin, S.D.; Liedo, P.; Ortiz, G.; Reys, J.; Schwarz, A. (Direccion de Sanidad Vegetal y Centro de Investigaciones Ecologicas del Sureste, Monterry, Mexico; Direccion de Sanidad Vegetal, Secretaria de Agricultura y Recursos Hidraulicos, Mexico). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12507 (INIS-BR—567, pp 66) **Determination of sterilizing doses of gamma radiation on imagos of Callosobruchus analis (Fabr., 1755) and C. maculatus (Fabr.,1792) in Cicer arietenum CV. 'grao de bico' and Vigna Sinensis CV. 'serido'.** Arthur, V.; Wiendl, F.M.; Walder, J.M.M. (Escola Superior de Agronomia de Paraguacu Paulista, Sao Paulo, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12508 (INIS-BR—567, pp 67-68) **Influence of two Phaseolus vulgaris cultivars on the determination of the gamma radiation sterilizing dose in imagos of Acanthoscelides obtectus (Say, 1831) (Col., Bruchidae).** Arthur, V.; Wiendl, F.M.; Walder, J.M.M.; Lopes, L.A. (Escola Superior de Agronomia de Paraguacu Paulista, Sao Paulo, Brazil; Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE87700442. (CONF-8411283—Absts.).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

12509 (INIS-mf—10497, pp 69) **Study of the combined effects of nitrogen gas and gamma radiation on Tribolium Confusum.** Bali, C. (CEA, Syria). 1986. (In French and Arabic). NTIS (US Sales Only), PC A06/MF A01. File Number DE87780055. (CONF-8603164—Absts.).

From 2. Arab congress of plant protection; Damascus, Syria (24 Mar 1986).

12510 (INIS-mf—10497) **Second Arab congress of plant protection. Abstracts book.** (Arab Agronomists Union, Damascus (Syria); Arab Society for Plant Protection, Beirut (Lebanon)). 1986. 117p. (In French and Arabic). (CONF-8603164—Absts.). NTIS (US Sales Only), PC A06/MF A01. File Number DE87780055.

From 2. Arab congress of plant protection; Damascus, Syria (24 Mar 1986).

Items within the scope of EDB have been entered individually into the data base.

12511 (INIS-XN—54) **Epidemiological studies of groups with occupational exposure to radiation.** Davies, J.M. (Nuclear Energy Agency, 75 - Paris (France)). 1985. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700438.

Also published in French.

The exposure of man to radiation and the resulting risk of carcinogenesis continues to be of concern to the public. In this context, there is often a tendency to carry out epidemiological studies concerning the induction of cancer in radiation workers and members of the public which are not supported by a statistically valid data base or whose results are misinterpreted or misused. To assist national authorities in evaluating radiological risks, the Nuclear Energy Agency has sponsored a critical review of the methodologies for, and the limitations of, these epidemiological studies, and of the precautions to be adopted in interpreting their results. Prepared by a consultant, Dr. Joan M. Davies, the review focuses on the problems encountered when carrying out epidemiological studies on groups of workers occupationally exposed to radiations, and using their results for radiological protection purposes. It is published under the responsibility of the Secretary General of the OECD, and does not necessarily reflect the views of Member Governments. The primary objective is to provide background material to be used by national authorities that have responsibilities in the field of radiological protection as well as by other persons interested in this subject.

12512 (NUREG/CR—3469-Vol.3) **Occupational dose reduction at nuclear power plants: Annotated bibliography of selected readings in radiation protection and ALARA.** Baum, J.W.; Khan, T.A. (Brookhaven National Lab., Upton, NY (USA)). Oct 1986. Contract AC02-76CH00016. 124p. (BNL-NUREG—51708-Vol.3). NTIS, PC A06/MF A01 - GPO. File Number TI87003791.

This report is the third in a series of bibliographies supporting the efforts at Brookhaven National Laboratory on dose reduction at nuclear power plants. Abstracts for this report were selected from papers presented at recent technical meetings, journals and research reports reviewed at the BNL ALARA Center, and searches of the DOE/RECON data base on energy-related publications. The references selected for inclusion in the bibliography relate not only to operational health physics topics but also to plant chemistry, stress corrosion cracking, and other aspects of plant operation which have important impacts on occupational exposure. Also included are references to improved design, planning, materials selection and other topics related to what might be called ALARA engineering. Thus, an attempt has been made to cover a broad spectrum of topics related directly or indirectly to occupational exposure reduction. The report contains 252 abstracts and both author and subject indices.

12513 (NUREG/CR—4754) **Value-impact study for implementation of a portable health physics instrumentation performance standard.** Merwin, S.E.; Swinth, K.L.; Herrington, W.N. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1986. Contract AC06-76RL01830. 78p. (PNL—6025). NTIS, PC A05/MF A01 - GPO. File Number TI87003813.

The American National Standards Institute (ANSI) Standard N42.17A "Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Normal Environmental Conditions" establishes minimum acceptable performance criteria for health physics instrumentation used in ionizing radiation fields. If the standard is adopted, Nuclear Regulatory Commission (NRC) and Agreement State licensees may be required to use instruments that meet ANSI N42.17A performance testing criteria. This report examines the costs and benefits of three potential NRC actions that would encourage industry-wide acceptance of the standard. These alternatives are: (1) NRC regulation requiring licensees to use instruments that have successfully passed performance testing against ANSI N42.17A, (2) recommending and encouraging the use of such instruments through publication of a regulatory guide endorsing ANSI N42.17A, and (3) taking no regulatory action and relying on a voluntary industry program. In this report, these alternatives are analyzed with respect to their probable impacts on NRC and Agreement State licensees. The net benefit of each option is estimated and a course of action is recommended. The purpose of this report is to recommend the best course of action available to the NRC based on the expected benefits from implementing ANSI Standard N42.17A. 46 refs., 24 tabs.

12514 (PNL-SA—14187) **Optical readout method for solid-state dosemeters.** McDonald, J.C.; Eichner, F.N.; Stahl, K.A.; Miller, S.D. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 13p. (CONF-860806—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003405.

From 8. international conference on solid state dosimetry; Oxford, UK (26 Aug 1986).

The readout of solid-state dosemeters is usually accomplished by heating to produce thermoluminescence. This technique has several disadvantages including stressing the dosemeter crystals, melting Teflon enclosures, and destroying the thin dosemeters designed for beta particle measurements. An optical readout method is being developed to avoid these difficulties. Standard dosemeters were irradiated to a dose of approximately 0.02 Sv with ^{137}Cs gamma rays. The dosemeters were then irradiated with light produced by a high-intensity xenon lamp. Various wavelength bands, from the ultraviolet through the visible and to the near-infrared, were used. The degree of trap emptying was found to be proportional to the total optical power incident. With the intensities used in the preliminary experiments, over 90% trap emptying was achieved. This new technique will prove useful for dosemeters that are encased in plastic for automatic processing. The details of this optical readout method, along with some possible applications in neutron and beta dosimetry are described. 7 refs., 3 figs.

12515 (PNL-SA—14415) **Statistical analysis of health effects on workers at Hanford.** Gilbert, E.S. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 17p. (CONF-8610179—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003098.

From Washington State Public Health Association meeting; Pasco, WA, USA (23 Oct 1986).

A cohort study of workers employed by DOE contractors at Hanford is reported. The main reason for studying these workers is to determine if the exposure received as a part of their jobs has resulted in adverse health effects. Because workers at Hanford generally live as well as work in the community surrounding Hanford, this study provides some information regarding that question as well. Health effects data are limited to mortality data. It's very difficult to obtain reliable data on non fetal diseases, especially since

Washington does not have a state-wide tumor registry. This limitation is especially important in addressing questions regarding the releases of iodine 131 that occurred at Hanford in the forties and early fifties. The largest exposures from iodine 131 would be to the thyroid. Thyroid cancer and other thyroid diseases are not often fatal. Even mortality data, that is information on when workers die and what they die of, is not that easy to obtain, especially for workers who may die many years after leaving Hanford. In this study, information has been obtained primarily by periodic searches of Social Security Administration files for claims regarding former Hanford workers. 6 tabs.

12516 **Distribution of label after intragastric administration of ^{7}Be-labeled carbon to weanling and aged mice (42318).** LeFevre, M.E.; Joel, D.D. (Brookhaven National Lab., Upton, NY). *Proceedings of the Society for Experimental Biology and Medicine;* **182**: No. 1, 112-119(May 1986). Contract AC02-76CH00016.

Single doses of ^{7}Be-labeled carbon particles prepared by proton bombardment of carbon black were administered by gavage to weanling (4 weeks) and aged (18 months) mice. Body distribution of ^{7}Be radioactivity was determined 4 hr and 1, 2, 5 and 14 days later. The results were compared with those obtained after administration of a solution of $^{7}BeCl_2$. ^{7}Be radioactivity in nonintestinal tissues was 17-58 times greater in mice gavaged with the soluble salt than in those gavaged with the particles, indicating that particle-bound ^{7}Be was well confined to the gastrointestinal tract. Upper limits of the amount of labeled carbon remaining in intestinal Peyer's patches were as follows: 1 day: weanling, 1.8×10^{-3}%, old, 5.5×10^{-3}%; 15 days: weanling, 3.3×10^{-5}%, old, 8.4×10^{-5}%. The particles are potentially useful as models for diesel emissions or other particulate pollutants.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 10722

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 10753, 10898, 12247, 12292, 12300, 12310, 12327, 12344

12517 **(AD-A—173549/7/XAB) Research and development on inhalation toxicologic evaluation of red phosphorus/butyl rubber combustion products.** Aranyi. (IIT Research Inst., Chicago, IL (USA). Life Sciences Div.). Dec 1984. 533p. (IITRI-L—06139). NTIS, PC A23/MF A01.

Combinations of exposure concentrations, durations and frequencies were tested in four-week inhalation exposures followed by two weeks of recovery to define the interactive effects of these variables on biologic responses and to select the most-sensitive biologic response parameters for the subsequent subchronic studies. Response surface modeling was used for the experimental design and statistical analysis of the data. Results of preliminary testing suggested that exposure duration and frequency did not have major effects. Subsequently, male and female Sprague-Dawley rats were exposed in separate studies to RP/BR aerosols ranging from 0.40 to 1.20 mg/1 or to filtered air for 2.25 hr/day on four days/week for four weeks. Test-atmosphere monitoring data demonstrated that aerosol concentrations were consistently within 4% of the target values and mean particle size ranged from 0.44-0.64 μm with mean sigma g's of 1.66-1.97. During the exposure period, wheezing and labored breathing were observed in male rats exposed to the high dose. Decreased body weights, body weight gains and reduced food consumption seen in male rats only at all concentration levels during the exposures returned to normal after the recovery period. Various biological endpoints were examined within 1-hr after the last exposure, and for selected treatment groups after a 14-day recovery period.

12518 **(ANL/AA—32) Assessing the risks to young children of three effects associated with elevated blood-lead levels.** Wallsten, T.S.; Whitfield, R.G. (Argonne National Lab., IL (USA)). Dec 1986. Contract W-31-109-ENG-38. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87004219.

Formal risk assessments were conducted as part of the US Environmental Protection Agency's current review of the primary National Ambient Air Quality Standard for lead. The assessments focused on three potentially adverse effects of exposure to lead in children from birth through the seventh birthday: erythrocyte protoporphyrin (EP) elevation, hemoglobin (Hb) decrement, and intelligence quotient (IQ) effect. The same general strategy was followed in all three cases: for two levels of each effect, probability distributions over population response rate were estimated at a series of blood-lead (PbB) levels. These distributions were estimated from data in the case of EP elevation and from expert judgements in the cases of Hb decrement and IQ effect. Although of interest in their own right, these estimates were combined with PbB distributions to yield probability distributions over the estimated percentages of children experiencing the particular health effects. 15 refs., 24 figs., 24 tabs.

12519 **(DOE/ER/60080—1) Methylated polynuclear aromatic hydrocarbons: Structural requirements for mutagenic and tumorigenic activity: Final progress report, 9-1-82 to 10-31-86.** LaVoie, E.J. (American Health Foundation, Valhalla, NY. Naylor Dana Inst. for Disease Prevention). 23 Sep 1986. Contract AC02-82ER60080. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003414.

Methylated polynuclear aromatic hydrocarbons (PAH) often possess exceptional mutagenic and carcinogenic activity which would not have been anticipated on the basis of the activities of their unsubstituted parent hydrocarbons. Whereas minor amounts of these compounds are generally formed as combustion by-products, significantly higher levels have been found in shale and coal-derived oils. This observation and the fact that subfractions rich in methylated PAH are carcinogenic in laboratory animals prompted this study of the potential effect on health of methylated PAH. The structural features of methylated tri- and tetracyclic PAH which determine their mutagenic and/or tumorigenic potential were sought and their role in the carcinogenicity of energy-related materials was studied. Methylated fluorenes, anthracenes, phenanthrenes, and pyrenes were synthesized and used to assay mutagenicity with respect to molecular structure in S. typhimurium strains TA 98, and TA 100. 54 refs., 35 figs.

12520 **(DOE/EV/10566—7) Mechanisms of mutagenesis: Analysis through the use of alcohol dehydrogenase in Drosophila: Final report.** Sofer, W.H. (Rutgers--the State Univ., Piscataway, NJ (USA). Waksman Inst. of Microbiology). Dec 1986. Contract AC02-81EV10566. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003871.

Our original objective was to understand the mechanism of mutagenesis of several important mutagens in higher organisms. Our approach was to try to deduce this mechanism by working backwards from its final effects. The strategy that we used in an effort to carry out our studies was to make mutations in the alcohol dehydrogenase gene of Drosophila melanogaster and sequence the modified genes. Most of our work was focused on an array of mutants that we had induced with formaldehyde, a potent mutagen in Drosophila, and with ethyl methane sulfonate. Over the course of the project period we cloned and sequenced the ADH gene from four formalde-induced mutants and from one EMS mutant. We showed that the four formaldehyde-induced mutants contained small deletions within the protein-coding region of their ADH genes ranging in size from between 6 and 34 bp. The one EMS-induced mutant was shown by DNA sequencing to bear an AT to GC sequence change at a tryptophan codon near the c-terminal coding portion of the gene. These results have significantly increased our understanding of the mechanism(s) of mutagenesis in higher organisms. 20 refs., 1 fig.

12521 (INIS-BR—559, pp 119-124) **Residual effect on sugar cane ratoon of urea nitrogen foliar application to plant cane.** Trivelin, P.C.O.; Lara Cabezas, W.A.R.; Coleti, J.T. (Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil; Usina Sao Jose de Macatuba, Sao Paulo, Brazil). 1984. (In Portuguese). NTIS (US Sales Only), PC A12/MF A01. File Number DE87700441. (CONF-8411283—).

From Regional workshop on nuclear techniques in crop production; Piracicaba, Brazil (19 Nov 1984).

The residual effect of urea - N, foliar applied to plant cane, on sugar cane ratoon is studied. Sets grown in drums containing washed sand are used. 180 days from planting, foliar fertilizer (43.5% urea solution) labelled with 3.95 atom % ^{15}N is applied. The first harvest is made 7 days after application and final harvest of resprouting at 123 days.

12522 **(ORNL/TM—10237) In vivo toxicity of arsenic trioxide for human cells in diffusion chambers.** Ambrose, K.R.; Butler, T.A.; Callahan, A.P.; Ferren, L.A. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004054.

The diffusion chamber system was used to monitor the toxicity of trivalnet arsenic for human target cells in vivo. Cell-impermeable diffusion chambers containing human embryonic lung cells were implanted into the peritoneal cavity of hamsters that one day later were injected i.v. or i.p. with arsenic trioxide (As_2O_3) as aqueous solution (AsO_2^-). $^{74}AsO_2^-$ was employed to quantitate the concentration of arsenic reaching the chambered target cells and to describe the toxicokinetics of arsenic in the hamster. Trivalent arsenic induced a growth inhibition in the target cells with the dosage level determining the extent of inhibition at 24 h and the recovery of cell proliferation at 48 h. The maximum concentration of arsenic in the chamber fluid was detected 2 h post i.p. injection, after which the elimination of ^{74}As from the chamber fluid paralleled the decline of ^{74}As activity in the plasma of the host animal. Limited tissue distribution studies showed that arsenic was retained primarily in the pelt. 22 refs., 2 figs., 3 tabs.

12523 **(ORNL/TM—10251) Sample size and power calculations for tests on potential mutagens.** Gosslee, D.G. (Oak Ridge National Lab., TN (USA)). Jan 1987. 10p. NTIS, PC A02/MF A01. File Number DE87004044.

For the small proportions typical of many mutation studies, the ability of some statistical tests to detect real effects is poor due to the extreme conservatism of these tests of significance for small proportions. The curve separating the region where the arcsine test is conservative from the region where it is liberal is introduced in this paper. In the region where the arcsine test is conservative, the Fisher exact test is much more conservative than the arcsine test. A modification of the arcsine test is suggested to simplify the specification and calculation of sample size estimates for trials with a small proportion responding. The number of animals required with sufficient power to detect compounds which are mutagenic, as well as the power for a given number of animals, can be calculated easily. The main results are presented for equal numbers of animals in each of two groups with an indication of the formulas for groups of unequal size. 17 refs., 1 tab.

12524 **(PB—87-106241/XAB) Effects of ozone and sulfur dioxide mixtures on forest vegetation of the southern Sierra Nevada. Final report.** Taylor, O.C.; Miller, P.R.; Page, A.L.; Lund, L.J. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Mar 1986. 254p. NTIS, PC A12/MF A01.

In 1981 and 1982, a multidisciplinary study was conducted within a 32-mile zone from Oildale, CA eastward to points in the southern Sierra Nevada. Concentrations of sulfur in pine needles and lichens along transects tended to decrease with increasing elevation. Stable isotope ratios in soils and plant tissue ran counter to expectations because natural isotopic composition at greater distances is similiar to the source area. Recently germinated pine seedlings exposed to ozone and sulfur dioxide mixtures showed significant differences in root dry weight, suggesting that pollutant mixtures may affect seedling establishment. Surveys of the study area showed increased ozone damage to pines between 1977 and 1981. Sulfur dioxide did not appear to be acting jointly with ozone to cause existing injury.

12525 **(PB—87-106886/XAB) Long-term inhalation reproductive and teratogenic toxicity evaluation of nitrous oxide plus halothane. Final report.** (Hazleton Labs. America, Inc., Vienna, VA). 14 Nov 1975. 24p. NTIS, PC A02/MF A01.

The report discusses the long-term effects of exposure to nitrous oxide plus halothane on the reproductive performance of female rats and the development processes in their offspring. Exposure of mated female rats to the combinations of nitrous oxide and halothane results in reduced ovulation and implantation efficiency at the higher level of exposure during the first six days after mating and a slightly retarded development of the fetuses at both levels of exposure. Exposure to 10 parts per million (ppm) of halothane plus 500 ppm of nitrous oxide can cause toxic effects on reproduction in rats, which should be of concern to humans.

12526 **(TVA/ONRED/WRF—87/3) Bull Run Fossil Plant toxicity biomonitoring study.** Hackney, P.A.; Moses, J. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Nov 1986. 128p. NTIS, PC A07/MF A01. File Number DE87900346.

This report presents the results of toxicity testing of the whole waste discharge from the Bull Run Steam-Electric Plant ashpond. Water chemistry tests were conducted for heavy metals content and suspended solids. Both acute and chronic toxicity tests were conducted on Daphnia pulex, Ceriodaphnia spp., Pimephales promelas, Micropterus salmoides, Lepomis macrochirus, and Cyprinus carpio. (ACR)

12527 **(UCRL—95692) Testing systems for biologic markers of genotoxic exposure and effect.** Mendelsohn, M.L. (Lawrence Livermore National Lab., CA (USA)). 19 Nov 1986. Contract W-7405-ENG-48. 8p. (CONF-8610186—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003242.

From 9. symposium on statistics and the environment risk assessment and public policy; Washington, DC, USA (27 Oct 1986).

Societal interest in genotoxicity stems from two concerns: the fear of carcinogenesis secondary to somatic mutation; and the fear of birth defects and decreasing genetic fitness secondary to heritable mutation. There is a pressing need to identify agents that can cause these effects, to understand the underlying dose-response relationships, to identify exposed populations, and to estimate both the magnitude of exposure and the risk of adverse health effects in such populations. Biologic markers refer either to evidence in surrogate organisms, or to the expressions of exposure and effect in human populations. 21 refs.

12528 **Nutrient uptake and growth responses of Virginia pine to elevated atmospheric carbon dioxide.** Luxmoore, R.J.; O'Neill, E.G.; Ells, J.M.; Rogers, H.H. (Oak Ridge National Lab., TN). *Journal of Environmental Quality;* **15**: No. 3, 244-251(Jul-Sep 1986). Contract AC05-84OR21400.

One-year-old Virgina pine (Pinus virginiana Mill.) seedlings with native or Pisolithus tinctorius mycorrhizal associations were grown in pots with soil low in organic matter and in cation exchange capacity and were exposed to one of five atmospheric CO_2 levels in the range of 340 to 940 $\mu L/L$ in open-top field chambers. The mean dry weight of the seedlings increased from 4.4 to 11.0 g/plant during the 122-d exposure period. Significant increases in dry weight and uptake of N, Ca, Al, Fe, Zn, and Sr occurred with CO_2 enrichment. Greater chemical uptake was associated with greater root weight. Specific absorption rates for chemicals (uptake per gram of root per day) were generally not affected by CO_2 enrichment. The uptake of P and K was not increased with elevated CO_2, and these elements showed the greater nutrient-use efficiency (C gain per element uptake). The nutrient-use efficiency for N and Ca was not influenced by atmospheric CO_2 enrichment. Large increases in Zn uptake at high CO° suggested an increase in rhizosphere acidification, which may have resulted from the release of protons from the roots, since it was estimated that cation uptake increasingly exceeded anion uptake with CO_2 enrichment. Potassium, P, and NO_3^- concentrations in the pot leachate decreased with higher CO_2 levels, and a similar trend was found for Al and Mg. These results suggest that soil-plant systems may exhibit increased nutrient and chemical retention at elevated atmospheric CO_2.

12529 **Vertebrate fauna of the Idaho National Environmental Research Park.** Reynolds, T.D.; Connelly, J.W.; Halford, D.K.; Arthur, W.J. (Dept. of Energy, Idaho Falls, ID). *Great Basin Naturalist;* **46**: No. 3, 513-527(Jul 1986).

The Idaho National Engineering Laboratory (INEL) is an energy research and development site administered by the US Department of Energy (DOE). The Energy Reorganization Act of 1974 ordered the US Energy Research and Development Administration (precursor to DOE) to engage in environmental research related to the development of energy sources to advance the goals of restoring, protecting, and enhancing environmental quality. The INEL was designated the nation's second National Environmental Research Park (NERP) in 1975 to satisfy this directive. The NERP provides a controlled, protected, outdoor laboratory for environmentally related research to help achieve national environmental goals as stated in the National Environmental Policy Act (NEPA) of 1969. The NERP charter presents broad objectives which, in part, require that each NERP serve as a bench mark for quantitatively assessing and predicting the environmental impact of man's activities. The compilation of baseline data, including species lists and identification of ecological communities, is fundamental to the NERP objectives. Much of the research on individual species of wildlife found on the Idaho NERP has been published in the scientific literature or presented in theses, dissertation, or reports (vide Markham 1973, 1978, 1983). This paper represents a consolidation of those findings which, combined with unpublished information provide baseline data on the abundance, distribution, habitat preference and seasonal occurrence of the vertebrate species recorded on the Idaho NERP. 79 references, 1 figure, 4 tables.

12530 **Assessing and managing the risks of accidental releases of hazardous gas: a case study of natural gas wells contaminated with hydrogen sulfide.** Layton, D.W.; Cederwall, R.T. (Lawrence Livermore National Lab., CA). *Environment International;* **12**: No. 5, 519-532(1986). Contract W-7405-ENG-48.

Natural gas wells contaminated with the toxic gas hydrogen sulfide (i.e., sour-gas wells) pose potential health risks to workers and to nearby residents. The health risks are a function of the dose-response relationship of hydrogen sulfide, the likelihood of accidental releases, gaseous emission rates, the nature of releases at the well head, dispersion of the emitted gas, and the characteristics of the population at risk. Each of these factors are discussed and a risk analysis is presented of a hypothetical sour-gas well in the vicinity of Evanston, WY. It was found that the greatest risks for life-threatening effects would occur in the north-west downwind sector after a horizontal release of gas at the well. Subacute effects (e.g., respiratory irritation) after a vertical release of gas would occur primarily to the northeast. Management of health risks involves the use of techniques for preventing inadvertent releases and methods for limiting population exposures.

12531 **Overall and regional lung function in dogs exposed acutely to ozone.** Morgan, M.S.; Meyer, P.; Holub, R.; Frank, R. (Univ. of Washington, Seattle). *Environmental Research;* **38**: No. 2, 546-557(Dec 1985).

Regional distribution of ventilation and overall function of the lungs were compared in anesthetized, paralyzed, mechanically ventilated dogs exposed to ozone. Three animals were exposed at each concentration (0. 0.13, 0.22, and 0.45 ppm ozone) for 3 hr. There were no significant changes in pulmonary flow resistance, dynamic compliance, or flow rates derived from maximum forced expiratory maneuvers. The distribution of inspired gas was determined using air containing ^{13}N and a positron camera to follow wash-in in each of 80 or more regions of the lung. The mean wash in time (T) and its standard deviation did not change in sham-treated dogs, but T increased by 40 to 100% in exposed animals. Dogs showing increases in T also had increased frequency dependence of compliance. The changes in ^{13}N wash-in reflected less uniform distribution of ventilation, with the greatest disparity occurring between central and marginal regions. Altered regional mechanical function, in the absence of overall changes, suggested that the initial effect of ozone was on the small airways. The measurement may be a sensitive indicator of acute irritation in the lung periphery.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 11064

57 HEALTH AND SAFETY

12532 **(LA—10812-MS) Injury mortality among employees of Los Alamos National Laboratory: A pilot study.** Wiggs, L.D.; Weber, C.A.; Wilkinson, G.S. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003803.

Although injuries compose the fourth leading cause of death among the US population, little is known about this important cause of death. For this reason, we investigated mortality from injuries among a cohort of 23,217 Los Alamos National Laboratory employees. Characteristics of Laboratory employees dying from injuries were described and compared with those dying from noninjury causes. Special emphasis was placed on comparing job-related deaths with non-job-related deaths. A comparison of injury deaths with noninjury deaths showed no differences in sex or race. Significant differences were observed for education, duration of employment, and age at death, with persons dying from injury better educated, more likely to be employed at least one year, and more likely to die at an earlier age. When education was examined further, we found significantly more suicides and air/space accidents among college-educated members of the cohort and more motor vehicle fatalities among persons without a college degree. In this cohort, we identified 45 work-related deaths (all white male), 29 of which occurred during employment with the Los Alamos National Laboratory. A comparison of job-related injury deaths with non-job-related deaths, showed no differences in education. Suicides and motor vehicle accidents were predominant among non-job-related deaths, whereas the categories of other accidents (explosions, electrocutions, machinery accidents, and radiation accidents) and air/space accidents were th leading causes among the deaths on the job. We observed no differences in job classification when job-related deaths were compared with non-job-related deaths. 5 refs., 19 tabs.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 10923, 10931, 10956, 10957

12533 **(CBPF-NF—082/85) Geochronologic (K-Ar/Fission track) east-west profile of the Rio Grande do Sul shield.** Poupeau, G.; Baitelli, R.; Berbert, M.; Soliani Junior, E.; Kawashita, K.; Cesar, M.F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Geociencias; Sao Paulo Univ. (Brazil). Inst. de Geociencias; Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1985. 17p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700406.

An E-W sampling was executed from Pelotas to Dom Pedrito, Rio Grande do Sul state, for K-Ar and Fission-track (FT) dating. Within the Dom Feliciano Orogenic Belt, from pelotas to Pinheiro Machado, K-Ar in biotites increase from 530m.y. to 655 m.y., with a discontinuity at the level of the approx.10Km wide Cangacu cataclastic Zone. In two samples from the Rio de La Plata Craton, at the western end of our profile, hornblendes present K-Ar ages of 1.555m.y. and 1.594m.y. FT ages in apatites record cooling of these minerals below 120 + - 20°C. From Pelotas to Pinheiro Machado, four sample present concordant ages at 270 + - 10m.y., whiel western most sample records a later event at 216 m.y. From the structure of plateau-ages it is suggested that the events dated are two positive tectonic pulses. Examination of the sedimentary of the Parana Basin confirms this interpretation. We therefore dated isotopically, for the first time in Rio Grande do Sul basement, the ages of the two tectonic pulses wich affected the sedimentation in the Parana Basin.

12534 **(DOE/ET/12139—T2) Tioga Bentonite in the Appalachian Basin: Final report.** Dennison, J.M. (North Carolina Univ., Chapel Hill (USA). Dept. of Geology). Nov 1986. Contract AS05-76ET12139. 538p. NTIS, PC A23/MF A01; 1; GPO Dep. File Number DE87003866.

The Tioga Bentonite is an interval up to 258 ft (79 m) thick with several tuff layers. The top of the Tioga middle coarse zone marks the top of the Onesquethaw Stage of the Devonian System throughout 102,000 sq mi (265,000 sq km) in the Appalachian basin. This report lists well and outcrop data for 763 localities where the Tioga Bentonite has been identified in the Appalachian basin. A series of detailed stratigraphic cross sections of the Tioga ash beds shows the internal stratigraphy of the Tioga Bentonite and its relation to overlying and underlying strata. Details of the Tioga internal stratigraphy are portrayed of a series of maps. Grain size data for biotite, quartz, feldspar, zircon, and apatite are also portrayed on maps. All maps in this report are at a scale of 1:1,000,000. In a preliminary phase of this study, the Berea pluton near Fredericksburg, Virginia was considered the best fit for an intrusive equivalent of the volcanic root for the Tioga middle coarse zone, based on thickness and grain-size data of the middle coarse zone and a compatible mineralogy and age of the Berea pluton. It is now believed that the Virginia Blue Ridge and Piedmont were thrust westward many tens of miles by the Alleghany orogeny in Permian time and that the roots of the Tioga volcano may be present only in the subsurface, piercing upward through the true basement and through the Cambrian and Ordovician strata beneath the overthrust crystalline rocks of the Piedmont near Fredericksburg, Virginia. The Tioga volcanic plume of the middle coarse zone was dispersed across the Appalachian, Michigan, and Illinois basins by winds of the Devonian southern trade wind belt, where the Tioga eruptive center was situated before North America drifted to its present location.

12535 **(INIS-BR—562) Geochronologic (K-Ar/Fission Track) east-west profile of the Rio Grande do Sul shield.** Poupeau, G.; Baitelli, R.; Berbert, M.; Soliani Junior, E.; Kawashita, K.; Cesar, M.F. (Sociedade Brasileira de Geologia, Sao Paulo; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Rio Grande do Sul Univ., Porto Alegre (Brazil); Sao Paulo Univ. (Brazil). Inst. de Geociencias; Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1985. 14p. (In Portuguese). (CONF-8510375—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700407.

From 2. geology South Brazilian symposium; Florianopolis, Brazil (1 Oct 1985).

An E-W sampling was executed from Pelotas to Dom Pedrito, Rio Grande do Sul State, for K-Ar and fission-track (FT) dating. Within the Dom Feliciano Orogenic Belt, from Pelotas to Pinheiro Machado, K-Ar in biotites increase from 530 m.y. to 655 m.y., with a discontinuity at the level of the 10 km wide Cangacu cataclastic Zone. In two samples from the Rio de La Plata Craton, at the Western end of our profile, hornblendes present K-Ar ages of 1.555 m.y and 1.594 m.y. FT ages in apatites record the cooling of these minerals below 120+- 20°C. From Pelotas to Pinheiro Machado, four samples present concordant ages at 270+ -10 m.y., while the western sample records a later event at 216 m.y. From the structure of plateau-ages it is suggested that the events dated are two positive tectonic pulses. Examination of the sedimentary of the Parana Basin confirms this interpretation. We therefore dated isotopically, for the first time in Rio Grande do Sul basement, the ages of the two tectonic pulses which affected the sedimentation in the Parana Basin.

12536 **(ORNL/TM—9999) Fiscal year 1985 groundwater investigation drilling program at the Y-12 Plant, Oak Ridge, Tennessee: Environmental Sciences Division publication No. 2805.** Haase, C.S.; Gillis, G.A.; King, H.L. (Oak Ridge National Lab., TN (USA)). Jan 1987. Contract AC05-84OR21400. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003978.

Groundwater investigation drilling operations at ten formerly or currently used waste disposal sites in the Y-12 vicinity have been completed. A total of 4 core holes, 11 soil borings, and 55 groundwater investigation wells were drilled at identified locations. The objective of the drilling program was to characterize the geology and hydrology of the sites investigated so that an effective monitoring well network could be designed and installed. The basic approach followed at each of the sites was to identify the major features of subsurface geology and then install the necessary boreholes to investigate the hydrogeologic significance of such features. Initially, a core hole or relatively deep borehole was drilled at an up section location to determine the general components of the subsurface geology. Study of drill cores, cuttings, and geophysical logs from this initial borehole identified geohydrologically significant targets. Those identified for investigation during the second stage of drilling at a specific site include: (1) the top of the water table, (2) the interface between the base of soil and the top of weathered bedrock, (3) base of weather in the bedrock, (4) cavity zones near the base of weathering in the top of bedrock, (5) zones of high porosity in the unweathered bedrock, and (6) fractures or fractured zones within the unweathered bedrock. After the investigatory phase was completed, groundwater investigation wells were installed to provide additional subsurface geological data and to provide data on hydrostatic heads and water quality for the shallow-flow regime in soils and upper weathered-bedrock zone and for the deep-flow regimes within the bedrock below the zone of significant weathering. 24 refs., 16 figs., 3 tabs.

12537 **Smoothing unit vector fields.** Mendoza, C.E. *Mathematical Geology;* **18**: No. 3, 307-322(Apr 1986).

Data, each consisting of a unit vector and a position, are modeled as a smooth unit vector field plus random directional errors; the smooth unit vector field is estimated by fitting a spline to observations. The estimate is nonlinear; it is obtained with an iterative procedure in which, at each step, a least-squares smoothing spline is fitted to a set of pseudovalues. The resulting estimate is exemplified with a data set extracted from the literature in geology. The proposed estimate is compared, using the same data set with that obtained through suggestions of other authors, and is found to have attractive qualities. The use of plots of the resulting estimate to find the appropriate value of the smoothing parameter is emphasized throughout.

5802 Geophysics

REFER ALSO TO CITATION(S) 10841, 10842, 10939, 13005

12538 (CONF-8604196—Summs., pp 389-412) **Excitation, propagation, and detection of L/sub g/, S/sub n/, and P/sub n/ seismic waves from EUS earthquakes by regression analysis of RSTN data.** Goncz, J.H.; Dean, W.C. (Teledyne Geotech Alexandria Labs., VA). Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

In the course of studying the RSTN detection threshold the authors developed a technique using regression analysis that seems to yield much new information about the excitation and propagation of regional phases in EUS. Vertical component seismograms extending in time from before P arrival to after L/sub g/arrival were comb-filtered, and the maximum rectified signal amplitudes at predicted P/sub n/, S/sub n/, and L/sub g/ arrival times were picked. Nine filter f/sub k/ span the frequency range from 0.4 Hz to 20 Hz. Observed regional phase amplitudes are modeled with three parameters according to a regression model. Techniques are discussed briefly, and results are presented. 18 figures, 1 table.

12539 (CONF-8604196—Summs., pp 413-421) **Variability of regional phase properties from the Yellowknife earthquakes and aftershocks.** Hauk, T.F.; Jarpe, S.P. Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

This study was initiated to investigate the variability of regional phase properties using RSTN data of the recent Yellowknife earthquake sequence in Canada. The properties of regional phases examined were: (1) phase detection levels and their dependence on distance, (2) variations of group velocity that may hold implications for location techniques used for single station networks such as triangulation, and (3) variations in backazimuth estimates, which have

obvious application to location capabilities. This was a controlled experiment in that the data set used allows some parameters such as location propagation path and source mechanisms to be fixed so that those parameters have minimal influence on the variability of the regional phase properties to be examined. 6 figures.

12540 (CONF-8604196—Summs., pp 422-438) **Earthquakes source spectra to 15 Hz.** Chael, E.P. Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

The Miramichi, New Brunswick mainshock (m/sub bL/sub g// = 5.8) and 11 of its aftershocks were studied to determine the features of earthquake source spectra. The author analyzed the 1-15 Hz P waves of the Miramichi events as recorded at station RSNY ($\Delta = 6°$). The code of each P wave was effectively stationary for over 60 s after its onset, enabling stable estimation of the power spectrum. Spectral ratios between P waves of different events represent ratios of the source spectra, since travel paths and focal mechanisms were nearly identical for all of the records. Spectral ratios obtained from the data were compared with theoretical curves for source models with omega^{-2} and omega^{-3} roll-off above the corner frequencies. The data are in good agreement with predictions of the omega^{-2} model; the omega^{-3} model is not satisfactory, because it predicts greater variation in the spectral ratio across the 1-15 Hz band than observed. This result argues against earthquake/explosion discrimination techniques based on differences in high frequency radiation, since explosion spectra are generally believed to exhibit omega^{-2} roll-off as well. Comparison of the P-wave scaling at 15 Hz with the Rayleigh wave scaling at a period of 8 s indicated that stress drop increases slowly with seismic moment, though constant stress drop can not be definitely ruled out. 16 figures.

12541 (CONF-8604196—Summs., pp 441-450) **Detection of regional earthquakes in eastern North America using the RSTN in the frequency range 0.5 to 16 Hz.** Jarpe, S.P.; Hauk, T.F.; Nakanishi, K.K. Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

The Seismic Monitoring Research Program at LLNL is involved in an ongoing project to determine the desired characteristics of an to predict the performance of a Regional Seismic Monitoring System. The system would be used for in-country monitoring of a low-yield or comprehensive test ban treaty. The part of the project discussed here determines the detection capability of a given regional network, the RSTN, or conversely, determines what characteristics a regional network must have in order to achieve a given detection capability. For this study, the capability of the Regional Seismic Test Network (RSTN) to detect earthquakes at regional distances in eastern and central North America was assessed. This is a tectonic environment similar to that found in much of the Soviet Union. Specific questions were: (1) what phases and frequencies are most useful for regional detection? (2) What is the magnitude threshold for detection of regional events by a sparse network of 3-component stations? (3) What station spacing is necessary to adequately monitor a nuclear test ban treaty? The answers to the last two questions are closely dependent on each other and require definition of adequate monitoring and sparse station spacing. However, given those definitions, the results help answer these questions. 6 figures.

12542 (CONF-8604196—Summs., pp 451-467) **Single station detection and location of regional events.** Magotra, N.; Ahmed, N. (Univ. of New Mexico, Albuquerque, NM). Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

This paper presents a signal processing technique for event detection and source location using single station, three component, seismic data. The seismic event detection and source location (SEDSL) scheme monitors the level of coherent power in the horizontal components (North and East data channels) to detect events of interest (nuclear tests, earthquakes). Once an event is detected, SEDSL estimates the azimuth of the source as measured at the receiver (clockwise from due north), once again using the N and E data channels to perform this task. The vertical (Z) data channel is used to resolve the 180° ambiguity in the azimuth estimate. Distance to the source is determined from the time between the arrival of the P/sub n/ and L/sub g/ phases. The technique employed by SEDSL is related to the Karhunen-Loeve transform (KLT) used in data compression. It essentially searches (adaptively) the north-east plane for the direction along which the variance of the seismic data crosses an adaptive threshold. Since SEDSL is an adaptive scheme, it has various parameters that need to be tuned. Several tests were performed using synthesized and real data to determine how these parameters affect the algorithm's performance. Results of these tests indicate that SEDSL is a fairly robust scheme. 12 figures.

12543 (CONF-8604196—Summs., pp 468-478) **Core phases recorded by the RSTN.** Cummins, P. (Univ. of California, Berkeley). Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

As part of an attempt at resolving changes in material properties at the Earth's inner core boundary, the author cataloged 12 deep events in the southwest Pacific that were recorded by the RSTN in the distance range 105-140°. This spans the range of pre- to postcritical PKiKP and includes the interference head wave PKIKP + PKmIKP. The spectral amplitudes of this arrival were used to constrain the velocity gradient at the top of the inner core to be anomalously high, and some investigators suggest that broadband pulse shapes are capable of resolving fine details of Earth structure in such anamolous regions. Other studies indicate that the preferential absorption of high frequency body waves in the inner core alone with their weak dispersion is characteristic of an absorption peak that lies just above the frequency band of the available body wave data. The author hoped to confirm or deny some of these hypotheses by exploiting the short period system response of the RSTN as well as its favorable geographic orientation with respect to the above mentioned centers of seismicity. Some of the data cataloged so far are presented, as well as some of the observed spectral properties of the PKiKP + PKIKP + PKmIKP multiplet. Some of the possible implications for inner core structure are also discussed.

12544 (CONF-8604196—Summs., pp 479-503) **Direct measurement of the mantle attenuation operator from broadband P and S waveforms.** Choy, G.L. (Geological Survey, Denver, CO). Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

Broadband seismograms of body waves that are directly proportional to displacement and velocity in the frequency range from 0.01 to 5.0 Hz can not be obtained for most earthquakes of magnitude greater than about 5.5. These records are obtained either directly or through multichannel deconvolution of waveforms from digitally recording seismograph stations. In contrast to data from conventional narrowband seismographs, broadband records have sufficient frequency content to define the source time functions of body waves, event for shallow events for which the source functions of direct and surface-reflected phases may overlap. The extended bandwidth of spectral information is particularly useful for studies of frequency dependent attenuation. The RSTN Stations are crucial to such a study. Broadband P waves can be obtained from almost all GDSN and RSTN stations. However, broadband S waves are obtained, for the most part, from the RSTN stations.

12545 (CONF-8604196—Summs., pp 504-523) **Observations of body wave multipathing from RSTN data.** Chan, W.W.; Silver, P.G. (Teledyne-Geotech, Alexandria, VA). Aug 1986. NTIS, PC A23/MF A01. File Number DE86015486.

From RSTN/NORESS research symposium; Las Vegas, NV, USA (30 Apr 1986).

Subducted slabs represent the largest source of heterogeneity in the Earth mantle. The cold temperatures in the slab produce velocities 5 to 10% greater than those of the ambient mantle. Such a large velocity anomaly is known to have strong effects on both the

travel times and ray trajectories of body waves leaving intermediate- and deep-focus events. The perturbation in ray trajectory gives rise to the focusing and defocusing of seismic energy and the production of multipathing, where energy from an event arrives at a station by more than one path, giving rise to complex, long-duration signals. Using the intermediate-period channel broad-band data from the RSTN network, the authors studied body waves generated from deep-focus events in the Sea of Okhotsk region. They found that these phases are anomalously broadened and complex, which are most easily explained by multipathing. In arriving at this conclusion, they considered and rejected many other possible causes for these anomalous pulses, such as source complexity, a low-Q zone in the mid-lower mantle, a discontinuity in the lower mantle, and near-receiver structure of anisotropy. Ray-tracing results through a realistic thermal model for the slab beneath the Sea of Okhotsk indeed predicts that multipathing should be produced by the slab for the stations used.

12546 (DGMK—254, pp 5-55) **Experimental studies of the absorption of seismic waves.** Meissner, R.; Theilen, F.; Muckelmann, R.; Wiederhold, H. (Kiel Univ., Germany, F.R. Inst. fuer Geophysik). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

Absorption properties of sediments are studied by a number of different techniques. Laboratory experiments, vertical seismic profiling in boreholes, seismic measurements on land and at sea, and theoretical studies were used to reveal the absorption mechanism and the absorption properties of certain types of sediments. With 240 figs., 13 tabs.

12547 (DGMK—254, pp 57-81) **Estimation of the absorption of seismic waves.** Babbel, G. (Technische Univ. Clausthal, Clausthal-Zellerfeld, Germany, F.R. Inst. fuer Geophysik). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

The influence of the reflection coefficients on the estimation of the absorption was investigated. By means of simple synthetic examples it can be shown that they might affect the results in different ways, by increasing or decreasing the effect of the absorption. Only on condition that it is possible to separate the influence of the inelastic absorption effects and the effects of the reflection coefficients, may we obtain realistic Q-factors. Some possible methods of how this problem might be solved are discussed and tested by means of synthetic examples. The results show that in most cases the interpretation of field data can only give a rough estimate of Q. With 240 figs., 13 tabs.

12548 (DGMK—254, pp 83-119) **Determination of the attenuation of seismic waves from actual field data, as well as considerations to fundamental questions from model- and laboratory measurements.** Engelhard, L.; Doan, D.; Drews, P.; Gross, T.; Neupert, F.; Schoenfeld, U.; Dohr, G.; Sattlegger, J. (Technische Univ. Braunschweig, Germany, F.R. Inst. fuer Geophysik und Meteorologie; Preussag A.G. Erdoel und Erdgas, Hannover, Germany, F.R.; Sattlegger Ingenieurbuero fuer Angewandte Geophysik, Meppen, Germany, F.R.). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

The application of the spectral ratio and the velocity dispersion method to estimate the seismic wave attenuation has been studied in view of various sources of distortions. In detail, the frequency dependence of reflection and transmission due to the attenuation contrast, spectral side lobe distortions, interference from short-time multiples and the influence of velocity gradients were simulated and methods to resolve these problems were tested on the basis of synthetic seismograms. The methods have been applied to acoustic wavetrain data from boreholes and to surface reflection data. In the laboratory, attenuation measurements have been executes on borehole cores on the basis of the resonant bar method, including the detection of causal dispersion. Also pulse propagation methods have been applied. With 240 figs., 13 tabs.

12549 (DGMK—254, pp 121-165) **Absorption of seismic waves: Determination of attenuation from reflection seismic surveys and estimation of the attenuation of seam waves.** Knecht, M. (Prakla-Seismos G.m.b.H., Hannover, Germany, F.R.). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

In the first part of this paper the estimation of the Q-value from reflection seismograms is discussed. However, the estimation of the true intrinsic absorption is mostly difficult because structural effects cause an additional, apparent attenuation. Therefore an attempt was made to overcome this problem by using further information, namely well-data. If the reflectivity of the subsurface is known, the disturbing influences of the layered medium can be removed with sufficient accuracy. This method is discussed with the aid of synthetic and real data examples. In the second part the absorption function of seismic seam waves is derived. With 240 figs., 13 tabs.

12550 (DGMK—254, pp 167-201) **Investigations of seismic wave absorption by means of model-seismic experiments.** Behrens, J.; Kim, J.Y.; Neumann-Denzau, G. (Technische Univ. Berlin, Germany, F.R. Inst. fuer Angewandte Geophysik, Petrologie und Lagerstaettenforschung). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

This paper describes two major topics. The first is associated with an estimation of Q, the other one with a detection of lateral attenuation anomalies. A number of model-seismic measurements were performed on two-dimensional physical models. At first, using a simple measuring procedure, where source and receivers lie on a rectilinear profile, several techniques, such as amplitude decay method, spectral ratio, linear universe filter, and Wiener filter were tested. In addition, to overcome problems of interference, bandpass mapping technique was used in conjunction with a windowing operation. The attained experiences were further applied to the data obtained in vertical seismic profiling. Thereby some problems were revealed including the spectral instabilities. For the determination of lateral absorption inhomogeneities, various tomographical reconstruction techniques, such as Algebraic Reconstruction Technique, Back Projection Technique, and Simultaneous Iterative Reconstruction Technique were used. Model-seismic experiments showed that these techniques did not reconstruct the presupposed conditions exactly, but represent a possibility to detect attenuation anomalies. With 240 figs., 13 tabs.

12551 (DGMK—254, pp 203-238) **Measurements of Q on natural rock samples in different frequency ranges.** Burkhardt, H.; Paffenholz, J.; Schuett, R. (Technische Univ. Berlin, Germany, F.R. Inst. fuer Angewandte Geophysik, Petrologie und Lagerstaettenforschung). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

Apparatus and evaluation methods were developed and tested to determine the elastic and anelastic properties of sedimentary rock samples in two frequency ranges. In the seismic frequency range Young's modulus and shear modulus and the corresponding absorption factors were measured by means of stress-strain analysis. 1/Q and velocities of propagating compressional and shear waves were determined in the high frequency range 400 kHz to 5 MHz. A comparison of the results of both frequency ranges show that the saturation dependence of 1/Q is quite different, indicating that the absorption is caused by completely different mechanisms. Therefore the frequency range is of decisive importance, if absorption mechanisms are discussed. With 240 figs., 13 tabs.

12552 (DGMK—254, pp 239-276) **Experimental and theoretical petrophysical investigations on relations between the inelastic absorption in porous rocks and other petrophysical and reservoir parameters.** Schopper, J.R.; Riepe, L.; Debschuetz, W.; Jonas, M.; Kehse, R.; Pape, H.; Wehr, R. (Technische Univ. Clausthal, Clausthal-Zellerfeld, Germany, F.R. Inst. fuer Geophysik). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

A theoretical study has been made on different absorption mechanisms superimposed in situ, and their individual relations to common petrophysical quantities. The results have been compared with experimental data reported in the literature and within the project. Empirical findings checked well with theoretical predictions. With 240 figs., 13 tabs.

12553 (DGMK—254, pp 315-339) **Absorption of seismic waves in geothermally abnormal regions from seismic refraction data.** Grimsel, C.; Baier, B. (Frankfurt Univ., Germany, F.R. Inst. fuer Meteorologie und Geophysik). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

The absorption of seismic energy in the deeper regions of the earth's crust is essentially influenced by thermally activated processes. So data from two young rift areas - the Afar-Depression of Ethiopia and the so-called 'neovulcanic zone' of Iceland have been analysed; both have a temperature-depth gradient of around 50/sup 0/C/km. Measurements on a profile on the Ethiopian Highland served as a reference. Two techniques were tested, first the well-known method of spectral division and secondly a new method which evaluates the complex envelope of the cross-correlation-function of the wavelets in comparison. Both methods are based on the Q=const model. The results that were found indicate a Q of perhaps 400 to 800 for the Ethiopian Highland and 200 to 500 for the Afar-Depression. The Q-value of the 'neovulcanic zone' of Iceland may be of the order of 500. With 240 figs., 13 tabs.

12554 (IPT—1563) **Seismic risk map for Southeastern Brazil.** Mioto, J.A. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1984. 56p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87700436.

During the last few years, some studies regarding seismic risk were prepared for three regions of Brazil. They were carried on account of two basic interests: first, toward the seismic history and recurrence of Brazilian seismic events; second, in a way as to provide seismic parameters for the design and construction of hydro and nuclear power plants. The first seismic risk map prepared for the southeastern region was elaborated in 1979 by 6he Universidade de Brasilia (UnB-Brasilia Seismological Station). In 1981 another seismic risk map was completed on the basis of seismotectonic studies carried out for the design and construction of the Nuclear power plants of Itaorna Beach (Angra dos Reis, Rio de Janeiro) by IPT (Mining and Applied Geology Division). In Brazil, until 1984, seismic studies concerning hydro and nuclear power plants and other civil construction of larger size did not take into account the seismic events from the point of view of probabilities of seismic recurrences. Such analysis in design is more important than the choice of a level of intensity or magnitude, or adoption of a seismicity level ased on deterministic methods. In this way, some considerations were made, concerning the use of seisms in Brazilian designs of hydro and nuclear power plants, as far as seismic analysis is concerned, recently altered over the current seismic risk panorama.

12555 (PNL-SA—13833) **Geologic spatial analysis: A new multiple data source exploration tool.** Eliason, J.R.; Thiessen, R.L. (Pacific Northwest Lab., Richland, WA (USA); Washington State Univ., Pullman (USA). Dept. of Geology). Oct 1986. Contract AC06-76RL01830. 19p. (CONF-8609200—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003303.

From 5. thematic conference on remote sensing for exploration geology; Reno, NV, USA (29 Sep 1986).

A basic research program has been initiated to develop quantitative and predictive spatial analysis techniques for determining the relationships of geological, geophysical, and geochemical structures in the solid earth. This research initially focused on the analysis of geologic data sets that can be obtained with remote sensing systems. The primary data are digital elevation models (DEM) of the terrain that are used in combination with all other map and point data to develop data sets in a three-dimensional coordinate system. The final analysis relies on programs that have been developed to determine structural correlations of point, string, and vector data. The programs can accept seismic hypocenters, lithologic contacts, lineaments, mapped structures, crustal fractures, geochemical data, and geophysical data in digital form. In addition, a unique analysis of DEM data can be performed to determine fracture planes directly. Data input is in the form of digital three-dimensional coordinates of point, string, and vector data. Much of the required data, including the elevation model, can be provided by remote sensing techniques. Analysis of an area can provide three-dimensional structural data on folding, faulting, and fracturing. These structural characteristics can be related directly to map locations for planning and directing field studies and can also be used to evaluate geochemical and geophysical anomalies. The analysis also provides key data for interpreting regional and local stress fields, which are controlling deformation and fracturing processes. These output products can contribute directly to the maximum use of available data in planning and conducting an exploration program.

12556 (USGS-OFR—86-576) **Preliminary study of quaternary faulting on the east side of Bare Mountain, Nye County, Nevada.** Reheis, M.C. (Geological Survey, Denver, CO (USA)). 1986. Contract A108-78ET44802. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003844.

Active faults bound the east side of Bare Mountain. Geomorphic features, stratigraphy, and soil development indicate that two 3-km-long segments of the range-front fault probably last moved in Holocene or late Pleistocene time. Other segments of the fault have been quiescent since the late Pleistocene. Both late Pleistocene and Holocene deposits bury many faults east of the northern end of Bare Mountain. Two prospect pits on the range-front fault reveal evidence of recurrent late Quaternary movements. Both older and younger deposits in one pit are faulted, but fractures in the older unit do not extend up into the younger unit. Based on soil development, the older and younger fault episodes respectively are probably late Pleistocene and Holocene in age. Another pit shows carbonate-cemented fractures with slickensides in a late Pleistocene deposit, suggesting at least two late Pleistocene or Holocene fault movements. Middle to early Pleistocene and Tertiary deposits show evidence of recurrent faulting in many locations. Faults in these deposits are pervaded by secondary $CaCO_3$ and silica that commonly exhibit slickensides.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 11744

12557 (DGMK—254, pp 277-313) **High temperature experiments on the elastic and an elastic behaviour of magmatic rocks.** Kampfmann, W.; Berckhemer, H. (Frankfurt Univ., Germany, F.R. Inst. fuer Meteorologie und Geophysik). Mar 1986. Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

In Absorption of seismic waves (ASW). Final report.

Measurements of the complex shear modulus have been performed at various ultrabasic and basic rocks (dunite, peridotite, gabbro, and basalts) and a synthetic forsterite at temperatures between 600/sup 0/ and 1500/sup 0/C (depending on the sample material) and in the frequency range from 0.003 to 30 Hz under forced torsional oscillations. The maximum shear stress was 0.3 MPa and the deformations were of the order 5 . 10/sup -6/ to 5 . 10/sup -5/. Measurements of the electrical resistivity as a function of temperature have been carried out together with the mechanical experiments to indicate the beginning of partial melting. With 240 figs., 13 tabs.

12558 **(LA—10802-MS) Chemistry of diagenetically altered tuffs at a potential nuclear waste repository, Yucca Mountain, Nye County, Nevada.** Broxton, D.E.; Warren, R.G.; Hagan, R.C.; Luedemann, G. (Los Alamos National Lab., NM (USA)). Oct 1986. Contract W-7405-ENG-36. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87003802.

The chemistry of diagenetically altered tuffs at a potential nuclear waste repository, Yucca Mountain, Nevada is described. These tuffs contain substantial amounts of zeolites that are highly sorptive of certain radionuclides. Because of their widespread distribution, the zeolitic tuffs could provide important barriers to radionuclide migration. Physical properties of these tuffs and of their constituent zeolites are influenced by their chemical compositions. This study defines the amount of chemical variability within diagenetically altered tuffs and within diagenetic minerals at Yucca Mountain. Zeolitic tuffs at Yucca Mountain formed by diagenetic alteration of rhyolitic vitric tuffs. Despite their similar starting compositions, these tuffs developed compositions that vary both vertically and laterally. Widespread chemical variations were the result of open-system chemical diagenesis in which chemical components of the tuffs were mobilized and redistributed by groundwaters. Alkalies, alkaline earths, and silica were the most mobile elements during diagenesis. The zeolitic tuffs can be divided into three compositional groups: (1) calcium- and magnesium-rich tuffs associated with relatively thin zones of alteration in the unsaturated zone; (2) tuffs in thick zones of alteration at and below the water table that grade laterally from sodic compositions on the western side of Yucca Mountain to calcic compositions on the eastern side; and (3) potassic tuffs at the north end of Yucca Mountain. Physical properties of tuffs and their consistuent zeolites at Yucca Mountain may be affected by variations in compositions. Properties important for assessment of repository performance include behavior and ion exchange.

12559 (ORNL—6261, pp 162-165) **Nuclear waste chemistry.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

Several research topics in the Chemistry Division are directly related to chemical problems of high-level radioactive waste disposal. Safety analyses of radioactive waste disposal depend upon reliable prediction of radionuclide migration in the event of penetration of the nuclear waste repository by groundwater and flow of the groundwater to the accessible environment. Prediction of the migration rates of nuclides within host geological formations is dependent upon knowledge of sorption properties and chemical speciation of the nuclides. Programs are described for evaluation of the parameters affecting the sorption of Tc, Np, U, Sr, and Cs. Knowledge of the solubilities of nuclides, especially for reducing repository environments, is necessary for prediction of maximum concentrations of nuclides in the groundwaters. Solubility studies of Tc(IV) oxides are summarized. Other types of chemical support for assessment and evaluation activities are presented. 10 refs.

12560 **Uniaxial and triaxial mechanical experiments on rock salt samples from three gulf coast domes.** Price, R.H. (Geomechanics Division, Sandia National Laboratories). *Geophysical Research Letters;* **13**: No. 10, 1031-1034(Oct 1986).

Seventeen quasi-static experiments on rock salt from three gulf coast domes are presented. The experiments were run at a constant loading rate in compression and extension, over pressures ranging from 0.1 to 13.8 MPa and temperatures ranging from 22 to 100°C. Minor variations in sample grain sizes and composition did not appear to have distinct effect on strength and behavior trends. Specimen strength was directly related to the least principal stress and inversely related to temperature; furthermore, pressure and temperature increases resulted in larger axial strains to failure (ductility). While strengths in extension and compression were similar, ultimate strains were substantially higher in compression than in extension.

5804 Geochemistry

REFER ALSO TO CITATION(S) 10948, 11789

12561 **(LA—10840-T) Evaluation of stream sediments in areas of known mineralization, San Jose and Talamanca Quadrangles, Costa Rica: An orientation survey.** Arauz, A.J. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 150p. NTIS, PC E08/MF A01; GPO Dep. File Number DE87003797.

Includes 6 sheets of 48x reduction microfiche.

Costa Rica's compressional island arc-type tectonic setting and considerable geologic diversity hold great promise for future discovery of economic metallic deposits. The study constitutes an orientation investigation of stream sediment sampling techniques to establish optimum survey specifications for the regional geochemical survey coverage of the country. The study was conducted in two separate areas of known mineralization which represent distinctive tropical environments and different metallogenic provinces within Costa Rica: (1) the Esparza Area, which contains the Santa Clara Gold Mine, the largest in the country, and (2) the San Isidro Area, which contains a major copper prospect.

5805 Oceanography

REFER ALSO TO CITATION(S) 10953, 10954, 10955

64 PHYSICS I

REFER ALSO TO CITATION(S) 11441

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 11818, 12932

12562 **(AD-A—172609/0/XAB) Structure of the extended emission in the infrared celestial background.** Price, S.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 30 Sep 1986. 16p. (AFGL-TR—86-0195). NTIS, PC A02/MF A01.

The extended emission in the infrared celestial background may be divided into three main components: the zodiacal background, the large discrete sources in the galaxy, and the interstellar dust. The zodiacal background is due to the thermal reradiation of sunlight absorbed by the dust in the solar system. An earth-orbiting infrared telescope will detect the diffuse emission from this dust in all directions with maximum intensity lying roughly along the ecliptic plane where the density of dust is highest. Structure with scale lengths of 10° was measured in both the visual and infrared; finer structure was detected in the infrared by the Infrared Astronomy Satellite. H II regions, areas of ionized gas mixed with and surrounded by dust, are the brightest discrete objects in the galaxy in the long wavelength infrared re-emitted in the infrared with a range of temperatures characteristic of the thermal equilibrium for the surroundings of the dust. The emission from the interstellar dust produces a filimentary structured background, the infrared cirrus. The observed far-infrared color temperature of about 20-35K for the cirrus is consistent with emission-form graphite and silicate grains which absorb the interstellar radiation field. The much-larger LWIR color temperature is likely due to a greater abundance of sub-micron particles in the interstellar medium and, perhaps, from band emission due to polycyclic aromatic hydrocarbons. These galactic planes have full width at half maxima of about 2°.

12563 **(AD-A—172937/5/XAB) Narrow-band, slowly varying decimetric radiation from the dwarf M flare star YZ Canis Minoris.** Lang, K.R.; Willson, R.F. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 1 Mar 1986. 8p. NTIS, PC A02/MF A01.

Narrow-band slowly varying microwave radiation has been detected from the dwarf M star YZ Canis Minoris at frequencies near 1465 MHz. This quiescent, or nonflaring, emission cannot be

attributed to gyroresonant radiation from coronal loops; the loops would have to be more than 200 times the stellar radius in size with magnetic field strengths of H > or = 100 G at this distance. The narrow-band structure (Delta nu/nu > or = 0.1) of the slowly varying radiation cannot be explained by continuum emission processes. These observations may be explained by coherent burst mechanisms like electron-cyclotron masers or coherent plasma radiation. Maser action at the second harmonic of the gyrofrequency implies a longitudinal magnetic field strength of 250 G and an electron density of N/sub e/ = approx. 6 x 10^9/cm^3. Coherent plasma radiation at the second harmonic of the plasma frequency similarly requires N/sub e/ = approx. 6 x 10^9/cm^3 but a longitudinal magnetic field strength of H/sub L/ << 250 G. The slow variation of the narrow-band emission might be explained by the stochastic nature of continued low-level, coherent burst activity. There are possible analogies with narrow-band decimetric bursts observed on the Sun.

12564 **(AD-A—173265/0/XAB) Coronal plasmas on the sun and nearby stars.** Lang, K.R. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 1 Sep 1986. 12p. NTIS, PC A02/MF A01.

The Very Large Array(VLA) was used to observe solar microwave sources with second-of-arc angular resolution. Both the quiescent, or nonflaring, microwave sources and the flaring ones are usually resolved. They are often associated with the apex and/ or legs of the ubiquitous coronal loops, which heretofore have been observable only with x ray telescopes sent above the atmosphere. Multiple-wavelength VLA observations can specify the strength, evolution and structure of the magnetic fields in coronal loops, while also providing constraints on the electron density and electron temperature of the plasma trapped within the coronal loops. The next section briefly reviews the thermal radiation mechanisms that account for most of the quiescent emission, while also pointing out that current-amplified magnetic fields or non thermal radiation may be required in some instances. This is followed by a discussion of the 20 cm radiation of coronal loops and the thermal-cyclotron lines that accurately specify their magnetic field strength. The 20-cm and x-ray emission of the coronal plasma are then compared. The coronae of nearby stars are discussed where coherent radiation processes seem to prevail.

12565 **(AD-A—173279/1/XAB) Compact, variable, moving sources on the sun at 2-cm wavelength.** Lang, K.R.; Willson, R.F. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 1 Sep 1986. 8p. NTIS, PC A02/ MF A01.

The high angular resolution provided by the Very Large Array (VLA) permitted the spatial resolution of solar microwave sources and opened the way for comparisons with observations of similar angular resolution at optical and x-ray wavelengths. High-resolution VLA observations of solar-active regions at relatively long wavelengths of 6 cm and 20 cm have, for example, led to the discovery of the microwave counterpart of the ubiquitous coronal loops that had previously only been observed by x-ray telescopes lofted above the Earth's atmosphere. The microwave emission of the coronal loops is attributed to the gyroresonant radiation and / or the bremsstrahlung of million-degree thermal electrons trapped within the loops by strong magnetic fields; observations of this emission have provided valuable new insights into the nature of solar-active regions and eruptions from the Sun and nearby stars. In contrast, the short-wavelength 2-cm emission of solar-active regions is poorly understood. In spite of numerous VLA solar observations at 2 cm, there are only two published results. In both instances, compact (angular sizes about 15 sec.), highly polarized (degree of circular polarization 80% to 90%) sources were found in regions of strong magnetic field strength (H about 2000 G) above sunspots.

12566 **(AD-A—173330/2/XAB) Solar gradual hard x-ray bursts and associated phenomena.** Cliver, E.W.; Dennis, B.R.; Kiplinger, A.L.; Kane, S.R.; Neidig, D.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 15 Jun 1986. 17p. (AFGL-TR—86-0215). NTIS, PC A02/MF A01.

From an examination of the white light coronagraph, H/sub alpha/, and radio (microwave, decimetric, and metric) data associated with a sample of 10 gradual hard x-ray bursts (GHBs) observed with the Hard-X-Ray-Burst Spectrometer on SMM and the x-ray detector on ISEE 3, was found the following: (1) The hard (somewhat > 30 keV) X ray photon energy spectrum began to harden near the onset of the GHBs, became systematically harder through the peak of the events, and continued to harden (or at least did not become softer) during the decay phase. (2) A coronal mass ejection (CME) was observed, or inferred to have occurred, in association with at least nine of the 10 GHBs, and CMEs appeared to precede the GHBs, by times ranging from 5 to 60 minutes. (3) The GHBs characteristically occurred in the late phase of major flares; in general, the changes in H/sub alpha/ flare brightness and area during GHBs were small and not commensurate with their associated microwave-burst peak intensities. (4) The centimeter wavelength bursts associated with the GHBs had relatively low frequency spectral maxima, and were microwave rich in relation to the observed hard x-ray emission. (5) The associated decimetric bursts typically exhibited significant intensity variations on time scales of from about 0.1 to somewhat > 1 minute, short in comparison with the somewhat > 10 minute durations of the gradual x-ray/microwave bursts. (6) The GHBs were poorly associated with the coincident metric type-II bursts and more strongly associated with type-IV or continuum events.

12567 **(AD-A—173523/2/XAB) Committee on solar-terrestrial research. Final report, 1 December 1984-30 April 86.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 16 Jun 1986. 59p. NTIS, PC A04/MF A01.

The Committee on Solar-Terrestrial Research (CSTR) of the National Academy of Sciences was able to meet through AFOSR financial support. The Committee is a unique organization for the review, planning, and coordination of research involving the sun, the interplanetary medium, the magnetosphere, the ionosphere, and high-altitude neutral atmosphere. Members from the scientific community were able to give coordinate and provide updates of their agencies implementation of the National Solar-Terrestrial Research Program. At the last meeting, committee members reviewed operations are decisions of federal agencies on solar-terrestrial research and discussed future approaches to ensure a viable research program.

12568 **(ITF—85-121-R) Production and evolution of ionized hydrogen regions in process of massive star formation.** Kravchuk, S.G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700365.

It is shown that at the stage when protostellar envelopes are blown away dense (n sub(e)> =10sup(7) cm sup(-3)) circumstellar ionized regions having radii r sub(H long)< = 10^{14} cm are formed around stars with luminosities L < 10^4 Lsub(sun). These regions expand due to high Lysub(α) radiation pressure. Ultracompact (r sub(H long) approximately 10^{16} -10^{17} cm) H2 regions associated with OH maser sources are those which are formed around stars with Lsub(sun)> = 10^4 Lsub(sun). These objects display shell structure. At later stages compact H2 regions are formed. 27 refs.; 4 figs.

12569 **(LA-UR—86-3512) Theoretical and observational review of results on nova explosions occurring on ONeMg white dwarfs.** Starrfield, S. (Los Alamos National Lab., NM (USA); Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 7 Jul 1986. Contract W-7405-ENG-36. 13p. (CONF-860793—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001962.

From 2. IAP recontre on nuclear astrophysics; Paris, France (7 Jul 1986).

The nova outburst is the second most violent explosion that occurs in a galaxy. This review presents the recent observational and theoretical studies that have demonstrated that there exist two classes of nova outburst. One type of nova occurs on a CO white dwarf and the other type of nova occurs on an ONeMg white dwarf. The second class of outbursts are much more violent and occur much more frequently then the first class of outbursts. Hydrodynamic simulations of both kinds of outbursts are in excellent agreement with the observations. 51 refs.

12570 **(LA-UR—86-3796) A review of what numerical simulations tell us about the internal rotation of the sun.** Glatzmaier, G.A. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 13p. (CONF-8608137—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002915.

From National Solar Observatory symposium; Sun Spot, NM, USA (1 Aug 1986).

The simulated solar differential rotation from two independent numerical modeling efforts agree with each other and with present solar observations. The models solve the nonlinear, three-dimensional, time-dependent, anelastic equations of motion for thermal convection in a stratified, rotating, spherical shell. The simulated angular velocity in the convection zone is constant on cylinders coaxial with the rotation axis, maximum at the equator and decreasing with depth. The latitudinal variation of this angular velocity at the surface is in agreement with Doppler measurements of the solar surface rotation rate. The radial variation through the convection zone is consistent with the analysis of the rotational frequency splitting of solar oscillations. 15 refs., 5 figs.

12571 **(N—87-11651) Combined ultraviolet studies of astronomical sources. Semiannual Progress report, 1 February-31 July 1986.** Baliunas, S.L.; Dupree, A.K.; Elvis, M.; Huchra, J.P.; Kenyon, S.; Raymond, J.C. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Oct 1986. 11p. (NASA-CR—179784; NAS—1.26:179784; SAPR—12). NTIS, PC A02/MF A01.

Topics addressed include: Cygnus Loop; P Cygni profiles in dwarf novae; YY Gem; nova shells; HZ Herculis; activity cycles in cluster giants; Alpha Ori; metal deficient giant stars; ultraviolet spectra of symbiotic stars detected by the Very Large Array; time variability in symbiotic stars; blue galaxies; and quasistellar objects with x-ray spectra.

12572 **(N—87-11652) Far-infrared spectral studies from the G. P. Kuiper Airborne Observatory. Final Technical report, 1 October 1978-31 October 1986.** Harwit, M. (Cornell Univ., Ithaca, NY (USA)). Oct 1986. 8p. (NASA-CR—179879; NAS—1.26:179879). NTIS, PC A02/MF A01.

The grant to carry out far-infrared spectral studies of astronomical sources from the G. P. Kuiper Airborne Observatory was first funded in October 1978 and officially ended on October 31, 1986. During these eight years, a variety of previously undetected spectral lines was discovered, and these were used to determine the physical and chemical conditions prevailing in regions of active star formation. They served to clarify the nature of the ionized hydrogen regions often adjacent to star-forming clouds, the characteristics of shocks which may signify the onset of star formation, and the nature of coolants that channel away energy thus enabling a cloud to collapse to form new stars.

12573 **(N—87-11653) UV observations of blue stragglers and population 2 K dwarfs. Final Technical report, 1 July 1984-30 June 1986.** Carney, B.W.; Bond, H.E. (North Carolina Univ., Chapel Hill (USA)). 1986. 4p. (NASA-CR—179865; NAS—1.26:179865). NTIS, PC A02/MF A01.

Blue stragglers are stars, found usually in either open or globular clusters, that appear to lie on the main sequence, but are brighter and bluer than the cluster turn-off. Currently, two rival models are invoked to explain this apparently pathological behavior: internal mixing (so that fresh fuel is brought into the stellar core); and mass transfer (by which a normal main sequence star acquires mass from an evolving nearby companion and so moves up the main sequence). The latter model predicts that in the absence of complete mass transfer (i.e., coalescence), blue stragglers should be binary systems with the fainter star in a post-main sequence evolutionary state. It is important to ascertain the cause of this phenomenon since stellar evolution models of main sequence stars play such a vital role in astronomy. If mass transfer is involved, one may easily exclude binaries from age determinations of clusters, but if mixing is the cause, our age determinations will be much less accurate unless we can determine whether all stars or only some mix, and what causes the mixing to occur at all.

12574 **Cosmic-ray-produced gamma rays in planetary surfaces.** Reedy, R.C. (Nuclear Chemistry Group, Los Alamos National Lab., Los Alamos, NM 87545). pp 933-936 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

A major priority of future NASA planetary missions is the determination of the elemental compositions of solar system objects. Gamma-ray spectroscopy will probably be used soon to determine the surface compositions of Mars and other solar system objects. Neutrons induced by the cosmic rays produce many of the important γ-ray lines that escape from planets. Some measurements of the γ-rays produced by neutrons and protons with various energies have recently been made. However, many more nuclear measurements are still needed to plan for and to interpret the results from future planetary missions. Excitation functions for the production of γ-ray lines by both neutrons and protons are needed in calculating the fluxes of γ-rays in and above a planet's surface. Thick-target irradiations with high-energy protons have simulated the production of γ-rays by the cosmic rays, and more simulations are planned.

12575 **Some nuclear data needs in astrophysics.** Mathews, G.J.; Bauer, R.W.; Bloom, S.D.; Haight, R.C.; Howard, W.M.; Takahashi, K.; Ward, R.A. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA 94550). pp 835-852 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The authors discuss a number of astrophysical environments and how improved nuclear data could facilitate a better understanding of them. One area of interest includes proton and alpha-particle reactions with unstable nuclei which are necessary for understanding the nucleosynthesis and energy generation in hot hydrogen-burning environments. Efforts underway at LLNL and elsewhere to develop the technology for the measurement of these reaction rates are discussed. Heavy-element nucleosynthesis in the late stages of red-giant starts and supernovae requires a complete network of neutron capture rates and beta-decay rates favor nuclei near and far from stability. Experimental and theoretical efforts at LLNL to supply the input data and to model the nucleosynthetic environments are outlined. Suggestions are made as to which nuclear data are most critical for the various scenarios.

12576 **Radio survey of cataclysmic variable stars using the very large array.** Cordova, F.A.; Mason, K.O.; Hjellming, R.M. (Los Alamos National Lab., NM). *Publications of the Astronomical Society of the Pacific;* **95**: 69-71(Jan 1983).

Six cataclysmic variable stars were searched for 6-cm emission using the NRAO Very Large Array. The candidate stars were SS Cyg, U Gem, TT Ari, RW Sex, EX Hya, and AO Psc (H2252-035). None were detected; the flux density limits range between 0.1 and 0.4 mJy. These limits are, respectively, between a factor of 6 and 1.5 lower than the 6-cm emission detected from the magnetic binary AM Her by Chanmugam and Dulk. 17 references, 2 tables.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 12567

12577 **(AD-A—172906/0/XAB) Parallel current effects on auroral E-region plasma instabilities. Interim report.** Chaturvedi, P.K.; Huba, J.D.; Ossakow, S.L.; Satyanarayana, P. (Naval Research Lab., Washington, DC (USA)). 19 Sep 1986. 34p. (NRL-MR—5847). NTIS, PC A03/MF A01.

Consider the effect of a field-aligned current on the development of plasma instabilities in the auroral electrojet. It is found that the inclusion of the parallel current modifies the threshold criteria for the onset of the Farley Buneman instability, and may cause excitation of oblique ion sound waves. Appling these results to the

auroral E region, it is shown that they explain some observations of auroral irregularities, e.g., the presence of type I irregularities for subthreshold conditions (when the electron Hall drift is less than the ion-sound speed), and the observation of irregularities not highly field-aligned.

12578 **(AD-A—173040/7/XAB) Dynamic ionosphere over Arecibo: a theoretical investigation.** Crary, D.J.; Forbes, J.M. (Boston Coll., Chestnut Hill, MA (USA). Dept. of Physics). 1 Jan 1986. 8p. NTIS, PC A02/MF A01.

Numerical simulations of the F-region ionosphere over Arecibo, Puerto Rico, are presented. It is deduced from these simulations that the dynamic behavior of the Arecibo ionosphere, particularly the so-called midnight collapse phenomenon, is strongly influenced by the upward propagating semidiurnal tidal component of the neutral meridional wind excited below thermospheric levels. Presence of a nonlinear interactive coupling between the neutral wind and ion drag was found. The steep underside density gradients occurring in conjunction with the collapse are due to vertical shear in the meridional wind field associated with the propagating semidiurnal tide. These gradients are capable of triggering the gradient-drift instability, thus accounting for plasma irregularity formation and observations of VHF scintillations associated with the collapse phenomenon.

12579 **(AD-A—173179/3/XAB) Studies of the auroral-zone ionosphere using the MITHRAS data base. Fiscal years 1983-1985. Final report, October 1982-October 1985.** (Massachusetts Inst. of Tech., Cambridge (USA)). 26 Jun 1986. 21p. NTIS, PC A02/MF A01.

The Autmospheric Science group participated in the multi-radar MITHRAS experimental campaign. Coordinated observations of the earth's ionosphere, magnetosphere, and thermosphere were conducted using the Millstone Hill, Massachusetts, Chatanika, Alaska, and European EISCAT incoherent scatter radars in conjunction with a variety of ground-based and satellite experiments. Chatanika and EISCAT are about 11 hours apart in magnetic local time, and Millstone Hill precedes Chatanika and follows EISCAT by more than 6 hours. Each of the three radars was able to study auroal-zone latitudes, but at widely spaced longitudes. Hence the MITHRAS program was well suited to study the class of problems which involve universal time/local time ambiguities, or equivalenty, space/time differences. Set operating modes were used at the radar sites to best match the requirements of the several campaign objectives. The overall MITHRAS program was motivated by a desire to provide a well documented set of radar observations of the mid- and high-latitude ionosphere during the brief interval when three incoherent scatter facialities would be available. At Millstone Hill the MITHRAS program involved the development of specific radar operating modes and analysis techniques appropriate for multi-instrument studies. An extensive data set resulted from the campaign.

12580 **(AD-A—173300/5/XAB) Comparison of simultaneous Chatanika and Millstone Hill observations with ionospheric model predictions.** Rasmussen, C.E.; Schunk, R.W.; Sojka, J.J.; Wickwar, V.B.; de la Beaujardiere, O. (SRI International, Menlo Park, CA (USA)). 1 Jun 1986. 13p. NTIS, PC A02/MF A01.

As part of the MITHRAS program, the Chatanika and Millstone Hill incoherent-scatter radars made coordinated observations of the polar ionosphere on June 27 and 28, 1981. These data were compared with predictions made by a high-latitude ionospheric model. Qualitatively, the same features are evident in both the model and the radar data: fairly constant densities on the dayside with a mid-latitude trough forming poleward of 65° around 1900 MLT (magnetic local time). This trough is seen to extend equatorward with increasing MLT, such that the minimum densities occurring in the trough appear just after midnight around 60° dipole latitude. These features are primarily understood in terms of different regions of convection, further influenced by photoionization and vertical transport. The only areas of major disagreement between the measurements and model are noted in the auroral oval and at a portion of the times during which substorms occurred. Quantitatively, equally good agreement is obtained between the model predictions and the radar data. Densities predicted by the model are usually within 25% of those measured by the radars.

12581 **(AD-A—173539/8/XAB) Collisionless coupling in the AMPTE (Active Magnetospheric Particle Tracer Explorers) artificial comet. Memorandum report.** Papadopoulos, K.; Huba, J.D.; Lui, A.T. (Naval Research Lab., Washington, DC (USA)). 29 Sep 1986. 37p. (NRL-MR—5835). NTIS, PC A03/MF A01.

Analysis of previously reported observations of the solar-wind barium interaction associated with the AMPTE artificial comet release of December 27, 1984 is presented. Based on these results, it is argued that the solar wind couples momentum (and energy) to the barium ions through both laminar and turbulent processes. The laminar forces acting on the particles are the laminar electric and magnetic fields; the turbulent forces are associated with the intense electrostatic-wave activity. This wave activity is shown to be caused by a cross-field solar-wind proton barium-ion streaming instability. The observed wave frequencies and saturated amplitudes are consistent with theoretical analysis.

12582 **(UCRL—93077) Nonlinear conductivity induced by the passing of long intense em pulses (50 to 500 ns) near the earth's surface and in SF_6.** Yee, J.H.; Khanaka, G.H.; Mayhall, D.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 18p. (CONF-861240—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003397.

From 3. national conference on high power microwave technology for defense applications; Albuquerque, NM, USA (1 Dec 1986).

Two one-dimensional computer codes have been developed to study the passage of long intense microwave pulses through the atmosphere and SF_6. The objectives are to obtain information about the electron conductivity and density as well as plasma frequency during the passage of microwave pulses in such media. In the computer model, electrons are treated as a fluid, and their effect on the passing microwave pulse are determined via the simultaneous solution of Maxwell's equations and the electron fluid equations. The model should give fairly accurate predictions, because it takes into account such variables as ambient electron density, beam intensity, ionization (avalanche) and attachment rates, and pressure. 2 refs., 7 figs.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 11593, 11752, 12638, 12806

12583 **(AD-A—172840/1/XAB) Extreme-ultraviolet beam-foil spectroscopy of highly ionized neon and argon. Doctoral thesis.** Demarest, J.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Aug 1986. 187p. (AFIT/CI/NR—86-171D). NTIS, PC A09/MF A01.

A study of the extreme-ultraviolet radiation emitted by ion beams of highly ionized neon and argon after passage through thin foils was conducted. A grazing-incidence spectrometer was equipped with a position-sensitive microchannel plate (MCP) detector, which improved the detection efficiency by two orders of magnitude. The position information of the MCP was determined to be linear over 90% of the 50-mm-wide detector. Spectra spanning regions of over 100 A were accumulated at a resolution of less than 1 A. A wavelength calibration based on a second order equation of spectrometer position was found to result in an accuracy of - 0.1 A. Over 40 transitions of Ne VIII, Ne IX, and Ne X were observed in the wavelength region from 350 to 30 A from n=2-3,4,5; n=3-4,5,6,7,8; n=4-6,7; and n=5-9. An intensity calibration of the detection system allowed the determination of the relative populations of n=3 states of Ne VIII and Ne IX. An overpopulation of states with low orbital angular momenta support electron-capture predictions by the first-order Born approximation. The argon beam-foil data confirmed the wavelength predictions of 30 previously unobserved transitions in the wavlength region from 355 to 25 A from n=2-2; n=3-4; n=4-5,6,7; and n=6-8. Lifetime determinations were made by the simultaneous measurement of 26 argon lines in the spectral region from 295-180 A. Many of the n=2-2 transitions agreed well with theory.

12584 (AD-A—172859/1/XAB) Energy dependence of axial coherent bremsstrahlung at low accelerating voltages. Butler, J.H.; Spence, J.C.; Reese, G.; Humphreys, C.J.; Doole, R.C. (Arizona State Univ., Tempe (USA). Dept. of Physics). 1985. 13p. NTIS, PC A02/MF A01.

A high-voltage electron microscope was used to detect coherent bremsstrahlung (CB) peaks in x-ray spectra from 111 axially oriented silicon. Spectra taken at various incident-beam energies simultaneously exhibit three frequency harmonics corresponding to umklapp by reciprocal lattice vectors (approximately antiparallel to the beam) lying in the third-, fourth-, and fifth-order Laue zones. The spectral energies are quantitatively interpreted in terms of a unified Bloch-wave theory of radiation from fast charged particles in crystals; and the dependence of CB emission energy on accelerating voltage was studied in detail at low energies. Computed intensity calculations for the CB are in reasonable agreement with experiment and show the energy resolution needed to resolve the fine structure on CB lines.

12585 (BNL—38796) Experimental method for determination of the branching ratio of reemitted positrons. Schut, H.; van Veen, A.; Nielsen, B.; Lynn, K.G. (Brookhaven National Lab., Upton, NY (USA); Interuniversitair Reactor Inst., Delft (Netherlands)). 1986. Contract AC02-76CH00016. 18p. (CONF-860798—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002140.

From International workshop on slow positron beam techniques for solid state and surface studies; Norwich, UK (7 Jul 1986).

An experimental method is proposed and tested for the determination of the branching of positrons into positron surface states and positronium states. A study is made of positrons backdiffusing to the surface of incidence in variable energy positron beam experiments. The method is based on positronium fraction measurements using a Ge solid state detector under two experimental conditions (1) removal of the reemitted positrons from the sample surface and detector region and (2) attraction of reemitted positrons towards the sample surface by applying an electric field. It is shown that by this method the effect of a change in the surface condition on the positronium fraction can be separated from effects due to changes of the bulk defect population.

12586 (CONF-8609207—1) Dielectronic recombination of multiply charged ions. Datz, S.; Dittner, P.F.; Fou, C.M.; Miller, P.D.; Pepmiller, P.L. (Oak Ridge National Lab., TN (USA); Delaware Univ., Newark (USA). Dept. of Physics). Sep 1986. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001689.

From Conference on the physics of multiple charged ions; Groningen, Netherlands (17 Sep 1986).

Using a merged electron-ion merged beam apparatus in conjunction with the ORNL EN Tandem Van de Graaff, we have measured dielectronic recombination in $\Delta n = 0$ transitions for a number of Li-liked (B^{2+}, C^{3+}, N^{4+}, and O^{5+}), Be-like (C^{2+}, N^{3+}, and O^{4+}), B-like (N^{2+}, O^{3+}, and F^{4+}), and Na-like (P^{4+}, S^{5+}, and Cl^{6+}) ions. The results are compared with theory which includes field enhancement and extension of the more highly charged ions is discussed. 11 refs., 11 figs.

12587 (CONF-8609207—2) Electron impact ionization of Ar^{8+}. Defrance, P.; Rachafi, S.; Jureta, J.; Meyer, F.; Chantrenne, S. (Oak Ridge National Lab., TN (USA); Louvain Univ., Louvain-la-Neuve (Belgium). Inst. de Physique; Belgrade Univ. (Yugoslavia). Inst. za Fiziku). 1986. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000994.

From Conference on the physics of multiple charged ions; Groningen, Netherlands (17 Sep 1986).

Absolute electron impact ionization cross-sections have been measured for the Neon-like Ar^{8+} in the energy range from below the threshold for the metastable state to 2500 eV. No contribution of metastable states is observed. The results are well reproduced by the Distorted Wave Born Approximation. 12 refs., 1 fig.

12588 (DOE/ER/13243—3) Multilevel relaxation phenomena and population trapping: [Progress report], July 1, 1984-June 30, 1987. Hioe, F.T. (Saint John Fisher Coll., Rochester, NY (USA)). Jan 1987. Contract FG02-84ER13243. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004134.

This research program is directed toward the studies of multiphoton and multilevel coherent effects in laser-induced excitation of atomic and molecular systems. The newly discovered dynamic symmetries will be extended to a systematic classification of all possible SU(N) dynamic symmetries, and will be used to study systems involving continua as well as discrete energy levels, particularly multiphoton absorption above ionization threshold. Analytic solutions for four-state systems will be derived in relation to the study of quantum interference effect. The presence or absence of chaos and phase transitions in multimode lasers will also be explored. 46 refs., 3 figs., 7 tabs.

12589 (IAE—4058/1) Effect of muon-nucleus weak neutral interaction in the 2s → 1s conversion transition of the light μ-minus-mesic atom. Romanov, S.V.; Grechukhin, D.P.; Soldatov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 39p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700339.

For light μ-minus-mesic atoms within the range of μHe-μSc discussed is a possibility of observation of the mixing effect of chemical bond2s>, chemical bond2p> mesic atom states of opposite parity, caused by weak neutral interaction of muon and nucleus and manifesting in anisotropy α of angular distribution of conversion electrons the (Eo+M1) 2s1/2 → 1s1/2 muon transition. Values of W_0 transitions probabilities are calculated for a series of configurations of electron shell of mesic atoms in the relativistic variant of the Hartree-Fock-Slater method values of amplification and anisotropy factors α in the case of conversion at Ns1/2 electron orbits (N=1, 2, 3, 4) are also calculated. It is found out that α value does not practically depend on N quantum number and electron configuration and for all mesic atoms except μHe, α is approximately 10sup(-6) (in μHe α approximately 10sup(-7)). On the contrary the conversion probability W_0 drops quickly with the N growth. So, electron line caused by conversion at K-shell appears to be the most suitable to observe the effect of parity non-conservation. 26 refs.; 8 tabs.

12590 (JINR—R-4-85-250) Perturbation theory for the hydrogen-like atom in a field of a point charge on the group O(4.2) basis. Vinitskij, S.I.; Kadomtsev, M.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700336.

Submitted to the journal J. Phys., A (Lett.).

In the group O/4.2/ an algebraic scheme of perturbation theory is proposed which enables one to find the energy and wave functions of bound states of a hydrogen-like atom in a field of a point chage placed at distance R larger than the size of atom. It is shown that in each order of R^{-1} the correction to the wave function is expressed through a finite number of Coulomb functions of the discrete spectrum with a modified charge. Simple analytical expressions are obtained for the first and second corrections. 17 refs.

12591 (PNL-SA—14084) Recent studies of simultaneous ionization and charge transfer in helium ion-atom collisions. DuBois, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76RL01830. 16p. (CONF-861114—34). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003306.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Ionization processes of atomic and molecular targets induced by light ion impact are reported. Generally these collisions are studied by monitoring the ejected electron spectra with the assumption that each ionizing event leads to a single secondary electron. One mechanism, which has until recently been disregarded as a

means of producing free electrons, is the possibility of capturing an electron from the target and simultaneously ionizing one or more target electrons. For ion impact velocities comparable to, or less than, the outer shell bound electron velocities, we have found that this can be a substantial, if not principal, means of producing free electrons. By measuring the target ionization charge states produced by directly ionizing and charge changing collisions, we have obtained cross sections for direct ionization, pure charge transfer, and charge transfer plus ionization. Several atomic targets have been studied. In addition to the importance of charge transfer plus ionization in producing free electrons, it was found that charge transfer plus ionization can sometimes be more probable that pure charge transfer. 9 refs., 4 figs.

12592 **(PUC-TN—31/84) Lennard-Jones triangular lattice gas in the Kikuchi approximation.** Osorio, R.; Koiller, B. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Aug 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700337.

The triangular lattice-gas problem for a model with infinitely repulsive nearest-neighbor and attractive second, J_2, and third-neighbor, J_3, interactions is studied in the Kikuchi approximation with a triangle of nearest-neighbor sites as the basic cluster. Values of the ratio αidentical to $J_3/J_2<1$ correspond to a Lennard-Jones interaction in a model for commensurate phases of submonolayers of inert gases adsorbed on graphite. A method of calculation is developed which allows a detailed study of the evolution of the phase diagrams - in particular the location of the liquid-gas critical endpoint and of the solid-liquid-gas triple point. Distinct liquid and gas phases are found to be stable for $\alpha>0.9481$.

12593 **(PUC-TN—39/84) 1sσ molecular orbital ionisation in asymmetric ion-atom collisions by direct Coulomb interaction.** Montenegro, E.C.; Sigaud, G.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Nov 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700340.

The adiabatic perturbation theory is applied to the ionisation of the 1sσ molecular orbital (MO) and extended to less adiabatic collisions by imposing an asymptotic matching with the semi-classical approximation. The transient molecular state wavefunction is modelled using the concept of an 'effective' charge for the colliding system. Through this procedure, the transition amplitudes are evaluated simulating both the relaxation of the passive electrons and the modification of the active electron wave-function, as well as their connection with the motion of the centre of charge during the collision. The direct Coulomb ionisation of the 1sσ MO is calculated for projectiles following hyperbolic paths, in terms of this 'effective' charge, using the current-vector formalism. Comparison is made with a large amount of experimental data showing good agreement.

12594 **(SAND—86-2501C) Quantum-resolved gas-surface scattering: NH_3 from Au (111).** Kay, B.D.; Raymond, T.D.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 5p. (CONF-870220–). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002699.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

We have measured angular, velocity, and quantum-state distributions for ammonia molecules scattered from a gold (111) single crystal for a number of surface temperatures and incident beam energies. A molecular beam source produces a well-collimated, rotationally cold (~15 K) beam of NH_3 molecules with a narrow dispersion of translational energy (~10%). The molecular beam impinges on an atomically clean, single crystal of gold (111) and the scattered NH_3 is detected in a quantum-resolved manner using two-photon resonant, three-photon ionization.

12595 **(UCRL—95563) Analysis and interpretation of a high density tandem negative ion source.** Hiskes, J.R.; Lietzke, A.F.; Hauck, C. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 22 Oct 1986. Contract W-7405-ENG-48. 16p. (CONF-8610115—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003245.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

In the last few years the development of tandem-discharge hydrogen-negative-ion-source systems has proceeded along both experimental and theoretical lines. To some extent these developments have proceeded independently, either the available theoretical model was inadequate to account for a specific geometrical configuration, or the experimental data was not sufficient to provide adequate input parameters for calculation. In the tandem system described here the electron temperature, electron density, and other relevant parameters have been obtained for a high-density system whose electron densities range up to 3 - 5 x 10^{12} electrons cm^{-3}. The model calculation for the atomic processes has been extended to include both electron density and electron temperature spatial variations through the second chamber. These spatial variations are essential for an adequate interpretation of tandem systems where steep density gradients may occur beyond the magnetic filter region. In this paper we shall combine the experimental density data with the new spatially dependent atomic model for the purpose of attempting a correlation of the observed and calculated current densities. 9 refs., 8 figs., 3 tabs.

12596 **(UCRL—95564) Electron excitation of $H_2(v'')$ levels to yield vibrationally excited H_2 molecules.** Hiskes, J.R. (Lawrence Livermore National Lab., CA (USA)). 21 Oct 1986. Contract W-7405-ENG-48. 7p. (CONF-8610115—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003246.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Electron excitation cross sections to produce vibrationally excited H_2 molecules are calculated for molecules initially in the first and second vibrational levels. The pattern of excitation cross sections as a function of final vibrational level v'' differs from that found in previous calculations initiated from the ground vibrational level. 2 refs., 3 figs.

12597 **(UCRL—95773) High-power pulse propagation experiments.** Alvarez, R.A. (Lawrence Livermore National Lab., CA (USA)). 2 Dec 1986. Contract W-7405-ENG-48. 6p. (CONF-870308—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003441.

From General meeting of the American Physical Society; New York, NY, USA (16 Mar 1987).

One of the questions that must be answered in assessing the potential of pulsed microwave beams as directed energy weapons is, "What is the maximum pulse energy (and/or peak power) that can be delivered from a source to a target." Atmospheric breakdown caused by the electromagnetic fields of the pulse sets one limit on energy propagation, and the breakdown threshold was the subject of fairly extensive investigation a number of years ago. The evolution of microwave source technology has extended the parameter range over which propagation needs to be understood, and additional issues that have not previously been investigated experimentally have assumed a new importance. A new generation of experiments is underway, planned, or proposed to investigate these issues. 13 refs.

12598 **(UCRL—95796) Simulation studies of ion dynamic effects on dense plasma line shapes.** Pollock, E.L. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 14p. (CONF-860864—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003440.

From Meeting on strongly coupled plasma physics; Santa Cruz, CA, USA (4 Aug 1986).

Computer simulations have been widely used in studying dense plasma properties including the local field properties important in spectral line broadening calculations. We will review here a more recent use of simulation, possibly less familiar to this audience, where the time dependent ionic microfield generated by computer simulation of a plasma is used directly as a time dependent external potential for the evolution of the electronic structure of an ion. This permits calculation of the dipole correlation function and

thus line shapes with the inclusion of ion dynamic effects. 12 refs., 7 figs.

12599 **Time-resolved studies of intense, relativistic electron beams with a subnanosecond C-hacekerenkov electro-optic shutter.** Hartemann, F.; Bekefi, G. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Applied Physics Letters;* **49**: No. 25, 1680-1682(22 Dec 1986).

Time-resolved studies of intense, relativistic electron beams using a novel subnanosecond C-hacekerenkov electro-optic shutter are described. The technique is applied to the measurements of the electron beam emittance from a multielectrode field emission gun (1.6 MV, 1 kA, 30 ns), and to the study of the stability of a rotating relativistic electron ring (200 kV, 100 A, 1 μs).

12600 **Laser-controlled collective ion accelerator.** O'Shea, P.G.; Destler, W.W.; Rodgers, J.; Segalov, Z. (Electrical Engineering Department and Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Applied Physics Letters;* **49**: No. 25, 1696-1698(22 Dec 1986).

We report first results from a new collective accelerator experiment in which a laser-controlled channel of ionization is used to control the propagation of the potential well at the front of an intense relativistic electron beam injected at currents above the space-charge limit. The controlled acceleration of protons at the rate of 40 MeV/m over a distance of 45 cm is reported, in good agreement with experimental design values.

12601 **Semiclassical methods in chemical physics.** Miller, W.H. (Lawrence Berkeley Lab., CA). *Science (Washington, D.C.);* **233**: 171-177(11 Jul 1986). Contract AC03-76SF00098.

Semiclassical theory finds use in chemical physics both as a computational method and as a conceptual framework for interpreting quantum features in experiments and in numerical quantum calculations. The semiclassical description of one-dimensional dynamical systems is essentially a solved problem for eigenvalue and scattering situations and for general topologies of potential functions (simple potential wells, multiple wells, multiple barriers, and so forth). Considerable progress has also been made in generalizing semiclassical theory to multidimensional dynamical systems (such as inelastic and reactive scattering of atoms and molecules and vibrational energy levels of polyatomic molecules), and here, too, it provides a useful picture of quantum features (interference in product state distribution, generalized tunneling phenomena, and others) in these more complex systems.

12602 **Computational and experimental short pulse, high power microwave air breakdown in a rectangular waveguide.** Mayhall, D.J.; Yee, J.H.; Alvarez, R.A.; Byrne, D.A. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 808, Livermore, CA 94550). pp 70 of Conference record of the 1986 IEEE international conference on plasma science. Piscataway, NJ; IEEE Service Center (1986). (CONF-860523—). Contract W-7405-ENG-48.

From 13. IEEE international conference on plasma science; Saskatoon, Saskatchewan, Canada (19 May 1986).

Experimental measurements of incident and transmitted power for short-pulse (3-10 nsec), high power (to 7 MW) microwave air breakdown with the TE10 mode at 2.856 GHz in WR-284 waveguide are performed for filling pressures from 3.5 to 500 Torr. Initially, natural preionization of the air was used. More recently preionization with a gamma ray source has been employed to enhance the reproducibility of the breakdown. One-dimensional, plane wave, finite difference computer code calculations with Maxwell's equations and the electron fluid equations for conservation of number density, transverse momentum, and energy are compared with experimental transmitted power. The electron fluid equations include collision frequencies for avalanche ionization and momentum and energy loss due to electron-neutral collisions. The agreement during the rise of the pulse is good, but that for the fall is poor. The calculated pulse drops rapidly, but the measured pulse falls much more slowly. Possible reasons for the disagreement are the transverse variation of the mode electric field across the waveguide and axial dispersion of the pulse as it travels down the waveguide. These are both two-dimensional effects. Two-dimensional, TE10 mode, finite difference computer code calculations show much better agreement with measurement for the fall of the transmitted power with time.

12603 **Photon energy dependent branching ratios of the inner valance satellites in the photoemission of solid ethylene.** Murgai, V.; Hulbert, S.L.; Johnson, P.D.; Strongin, M.; Eberhardt, W. (Brookhaven National Lab., Upton, NY). *Chemical Physics Letters;* **111**: No. 1-2, 157-160(26 Oct 1984). Contract AC02-76CH00016.

Measuring the photoelectron branching ratios of the outer and inner valence emission of ethylene as a function of photon energy between 40 and 200 eV, the authors are able to identify the various photoemission lines. As theory predicts, the single particle picture breaks down for the innermost valence orbital (2a/sub g/). The photoemission from this orbital is spread over two lines which are also degenerate with other excited state configurations of the ion. This leads to interference effects which are indeed observed in the cross section of these lines. 10 references, 2 figures.

12604 **Antiprotonic atomic energy levels via the (p vector, p) reaction.** Gibbs, W.R.; Kaufmann, W.B. (Los Alamos National Lab., NM). *Physics Letters [Section] B;* **145B**: No. 1,2, 1-3(13 Sep 1984).

Detection of hitherto unobservable low-lying levels of antiprotonic atoms, populated by (p vector, p) reactions, may be experimentally feasible and would shed light upon the threshold p vector-nuclear interaction. 5 references, 2 figures, 3 tables.

12605 **Photoelectron branching ratios and asymmetry parameters of the two outermost molecular orbitals of methyl cyanide.** Holland, D.M.P.; Parr, A.C.; Dehmer, J.L. (Univ. of Maryland, College Park). *Journal of Electron Spectroscopy and Related Phenomena;* **34**: 87-96(1984).

Vibrationally resolved photoelectron branching ratios and asymmetry parameters have been determined for the two outermost molecular orbitals of methyl cyanide. The results are discussed briefly within the context of similar studies on cyanogen and hydrogen cyanide, and in relation to structures exhibited in the photoionization efficiency curve. 30 references, 8 figures.

12606 **Inversion symmetry of hydrogenic expectation values.** More, R.M. (Lawrence Livermore National Lab., CA). *Journal of Physics B: Atomic and Molecular Physics;* **16**: 3859-3861(1983). Contract W-7405-ENG-48.

The authors have observed a surprising inversion property of the semiclassical expectation values for hydrogenic atoms, which shows that averages [r/sup j/] are proportional to averages [r/sup -(j+3)/] for any integer j. Non-relativistic quantum expectation values obey a modified form of the same symmetry. 13 references.

12607 **Charge distributions of barium isotopes from muonic x-rays.** Shera, E.B; Wohlfahrt, H.D.; Hoehn, M.V.; Tanaka, Y. (Los Alamos National Lab., NM). *Physics Letters [Section] B;* **112B**: No. 2, 124-128(6 May 1982).

The results of a muonic x-ray study of the charge radii of stable barium isotopes are presented and compared with optical isotope shifts. The isotope shifts $\Delta\langle r^2\rangle$ of a wide range of barium isotopes are found to be in good agreement with the droplet model and with IBA calculations. 15 references, 1 figure, 2 tables.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 12982, 13012

12608 **(AD-A—172786/6/XAB) Method for determining the high-energy photon spectrum of a pulsed plasma source. Master's thesis.** Beason, C.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1984. 128p. (AFIT/GNE/PH—84M-1). NTIS, PC A07/MF A01.

This investigation examined the feasibility of using an array of plastic scintillator photomultiplier tube radiation detectors to determine the high energy (h μ greater than 30 keV) photon spectrum of SHIVA STAR. A method of determining the spectrum is outlined in which the detectors are filtered with different materials, and the spectrum is deconvoluted by an iterative technique on a computer. Data from SHIVA STAR was not available, so measurements of the radiation output of a plasma gun were analyzed.

12609 **(DOE/ER/13044—6) [Systems near the onset and in the well-developed regimes of turbulence]: Research completed and in progress.** Siggia, E. (Cornell Univ., Ithaca, NY (USA). Dept. of Physics). 17 Dec 1986. Contract AC02-83ER13044. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003708.

Brief summaries of research by E. Siggia, M.J. Feigenbaum, and L. Chayes are presented. The research of E. Siggia concerns the study of singular solutions to the Biot-Savart model for a vortex filament, integrability for discrete Hamiltonian systems, and small divisor problems. M.J. Feigenbaum is studying the behavior of objects with highly complicated scaling properties. L. Chayes has focused on the mathematics and physics of disordered systems. Lists of publications for each researcher are included.

12610 **(LA—10853-MS) A generalized MAC [Marker-and-Cell] method for incompressible fluid flow.** Kashiwa, B.A. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003661.

A scheme for obtaining numerical solutions to the time-dependent incompressible fluid flow equations is presented. The method is designed for use on a computational grid of arbitrary polygons, and can be considered to be the Finite-Volume (FV) generalization of the Marker-and-Cell (MAC) method. A scheme resembling the advection method of van Leer is utilized in a way that yields second-order spatial accuracy and conditional stability with any level of fluid viscosity. The method is fully described in the presentation. Sample results are given for a variety of two-dimensional flow circumstances. These include non-viscous, viscous, steady, and unsteady flows on various non-orthogonal computational meshes. 10 refs., 7 figs.

12611 **(LA-UR—86-3785) Convectively driven superfluid turbulence in dilute solutions of ^{3}He in superfluid ^{4}He.** Ecke, R.E.; Haucke, H.; Wheatley, J. (Los Alamos National Lab., NM (USA)). Oct 1986. Contract W-7405-ENG-36. 25p. (CONF-8610184—1). NTIS, PC AA02/MF A01; 1; GPO Dep. File Number DE87002918.

From Conference on quantum fluids and solids; Banff, Canada (13 Oct 1986).

A dilute solution of ^{3}He in superfluid ^{4}He usually behaves as a single component classical fluid in the context of hydrodynamic convection. However, certain convective states can be excited which do not seem to exist in classical convection. These states are characterized by noisy temperature fluctuations and a pronounced decrease in thermal conductance relative to the classical convecting states. Critical convective flow fields are observed analogous to critical velocities for superfluid turbulence in pipes. The magnitude of the average critical velocities for these two types of superfluid turbulence are in good agreement. Also, a quantitative estimate of energy dissipation due to the interaction of normal fluid and quantized vortex lines appears to account for the large decrease in thermal heat transport for the turbulent states. These states are identified as states of convectively driven superfluid turbulence. 23 refs., 5 figs.

12612 **(PUC-TN—37/84) Two-dimensional superfluid transition in Hdown.** Mello, E.V.L.; Carneiro, G.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Nov 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700338.

The surface density as function of temperature for Hdown adsorbed on superfluid helium film is studied for several gas densities. The theory used is exact in the low density limit and predict Kosterlitz-thouless transition temperatures lower than previous calculation and also lower saturation density. The results confirm the possibility of a 2D superfluid transition under conditions close to those achieved experimentally.

12613 **(UCRL—95582) Turbulent energy generated by accelerations and shocks.** Mikaelian, K.O. (Lawrence Livermore National Lab., CA (USA)). 8 Oct 1986. Contract W-7405-ENG-48. 12p. (CONF-870235—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002377.

From 3. international conference on stratified flows; Pasadena, CA, USA (3 Feb 1987).

The turbulent energy generated at the interface between two fluids undergoing a constant acceleration or a shock is calculated. Assuming linear density profiles in the mixed region we find E/sub turbulent//E/sub directed/ = $2.3A^2$% (constant acceleration) and $9.3A^2$% (shock), where A is the Atwood number. Diffusion models predict somewhat less turbulent energy and a density profile with a tail extending into the lower density fluid. Eddy sizes are approximately 27% (constant acceleration) and 17% (shock) of the mixing depth into the heavier fluid. 6 refs., 3 figs.

12614 **Influence of damping in an electron gas on wake binding energies.** Ashley, J.C.; Echenique, P.M. (Oak Ridge National Lab., TN). *Physical Review [Section] B: Solid State;* **31**: No. 7, 4655-4656(1 Apr 1985). Contract AC05-84OR21400.

The binding energies of electrons trapped in the oscillatory wake of electron-density fluctuations trailing a fast ion in a solid are shown to decrease with increasing damping in an electron gas.

12615 **Nonlinear stability of asymptotic suction.** Miklavcic, M. (Univ. of Minnesota, Minneapolis). *Transactions of the American Mathematical Society;* **281**: No. 1, 215-231(1 Jan 1984). Contract AS05-80ER10711.

The semigroup approach to the Navier-Stokes equation in halfspace is used to prove that the stability of the asymptotic suction velocity profile is determined by the eigenvalues of the classical Orr-Sommerfeld equation. The usual obstacle, namely, that the corresponding linear operator contains 0 in the spectrum is removed with the use of weighted spaces. 13 references.

12616 **Overview of Rayleigh-Taylor instability.** Sharp, D.H. (Los Alamos National Lab., NM). *Physica D: Nonlinear Phenomena (Amsterdam);* **12D**: 3-18(1984).

The aim of this talk is to survey Rayleigh-Taylor instability, describing the phenomenology that occurs at a Taylor unstable interface, and reviewing attempts to understand those phenomena quantitatively. 65 references, 12 figures, 1 table.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 12699

12617 **(ANL-HEP-CP—86-113) D* width and the study of F and F*.** Sugano, K. (Argonne National Lab., IL (USA)). Jul 1986. Contract W-31109-ENG-38. 10p. (CONF-860701—32). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001550.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent results on the D*, F, and F* production in e+e- from HRS and MARK III are summarized. An improved upper limit on the decay width of D* is reported. A brief review of the characteristics of F and the updated data of the F production in e^+e^- are given. A new measurement on F* is made using the associated production method in the reaction $e^+e^- \rightarrow FF^*$.

12618 **(BNL—38910) Magnetic monopole catalysis of proton decay.** Marciano, W.J.; Salvino, D. (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 4p. (CONF-8606215—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003231.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

Catalysis of proton decay by GUT magnetic monopoles (the Rubakov-Callan effect) is discussed. Combining a short-distance cross section calculation by Bernreuther and Craigie with the long-distance velocity dependent distortion factors of Arafune and Fukugita, catalysis rate predictions which can be compared with experiment are obtained. At present, hydrogen rich detectors such as water (H_2O) and methane (CH_4) appear to be particularly well suited for observing catalysis by very slow monopoles. 17 refs., 1 fig.

12619 (BNL—39020) Comparison of quasielastic scattering nu/sub μ/N → μ^- P and Δ^{++} production reaction nu/sub μ/p → $\mu^-\Delta^{++}$ in the BNL 7-foot deuterium bubble chamber. Kitagaki, T.; Yuta, H.; Tanaka, S.; Yamaguchi, A.; Abe, K.; Hasegawa, K.; Tamai, K.; Kunori, S.; Otani, Y.; Hayano, H. (Brookhaven National Lab., Upton, NY (USA); Tohoku Univ., Sendai (Japan); Tohoku Gakuin Univ. (Japan)). 1986. Contract AC02-76CH00016. 16p. (CONF-8606201—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003489.

From Neutrino '86; Sendai, Japan (3 Jun 1986).

The neutrino quasielastic and delta-1232 production in nu/sub μ/d → μ^-pp and nu/sub μ/d → $\mu^-\Delta^{++}$n interactions have been studied using high statistics data obtained from a bubble chamber experiment at Brookhaven. Results on a detailed study of the axial form factor in these reactions are presented. In particular, assuming the dipole axial form factor, the behavior of the axial-vector mass is examined from the Q^2 distributions for these reactions. The reaction mechanisms are compared, and the similarity between these reactions are shown. (LEW)

12620 (CERN-EP—86-136) Future physics at LEAR [Low-Energy Antiproton Ring]. Landua, R. (European Organization for Nuclear Research, Geneva (Switzerland)). 24 Sep 1986. 29p. (CONF-8604201—7). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900144.

From Antimatter physics at low energies; Batavia, IL, USA (10 Apr 1986).

The main physics motivation of the experiments at LEAR in the post-ACOL phase is described: Test of fundamental symmetries, (CP, T, CPT) and of QCD at low energies. Short technical descriptions of the experiments are given, with special emphasis on ambitious new techniques.

12621 (DOE/ER/02504—452) High energy accelerator and colliding beam user group: Progress report, March 1, 1986-February 28, 1987. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Sep 1986. Contract AC05-76ER02504. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003322.

Work done for the OPAL collaboration at the LEP storage ring being constructed at CERN is reported. The main responsibility discussed is the construction, installation, and maintenance of the hadron calorimeter. Also reported are advances in the design of the OPAL software concerning data handling for the hadron barrel calorimeter. Also reported are experiments at DESY, including a study of electron-positron collisions at PETRA. Experiments at Fermilab are also discussed, including one on deep inelastic muon scattering at the Tevatron II and contributions to the development of the DO detector at Tevatron I. Yet another experiment, this one at Los Alamos, is in its final year of data taking and involves the observation and initial measurement of neutrino-electron elastic scattering. Computer experience in high energy physics is reported. Other activities reported include a neutrino deuterium bubble chamber experiment, and work on a polarized electron storage ring design for HERA. 164 refs., 17 figs. (LEW)

12622 (DOE/ER/03244—132) Search for a strangeness -2 dibaryon using a ^{3}He target: Report of the E-813 collaboration on plans for ^{3}He target version of the H dibaryon search. Franklin, G.B.; Barnes, P.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 26 Sep 1986. Contract AC02-76ER03244. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003381.

An experimental configuration is described that would search for the H dibaryon in the reaction $K^- + {}^3He \rightarrow K^+ + H + n$. In particular, the design of the K^+ spectrometer is discussed as well as event rate estimates and the technical details of the efficient background rejection required to make the experiment feasible. 7 refs., 11 figs. (LEW)

12623 (DOE/ER/03244—133) The anti pp yields anti λ λ reaction near threshold. Maher, C.J. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). Jun 1986. Contract AC02-76ER03244. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87003382.

Measurements of differential and integrated cross sections as well as final state polarizations for the anti p p → anti Λ Λ reaction are presented. The reaction was studied at two incident antiproton momenta (1476.5 MeV/c and 1507.5 MeV/c) corresponding to total center of mass energies of 15.5 MeV and 26.4 MeV above the reaction threshold. The trajectories of charged decay products of the anti Λ and Λ were observed in a multiwire proportional chamber and in two sets of drift chambers. The data were analyzed with a computer program which reconstructed anti p p → anti Λ Λ → anti p π^+ pπ^- events and performed kinematic fitting. The results are compared to several recent meson exchange calculations, and a one-gluon exchange calculation. The experiment was performed at the Low Energy Antiproton Ring (LEAR) at CERN. The data presented represent the first results of the PS185 collaboration's study of the threshold production of hyperon-antihyperon states.

12624 (DOE/ER/03244—135) The weak decay of hypernuclei. Franklin, G.B. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). [1986]. Contract AC02-76ER03244. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003928.

Hypernuclei whose ground states are stable against strong decay are used to study two-baryon weak interactions. A review of th existing experimental data, including recent results from the AGS on /sub $\Lambda/^{12}$C and /sub $\Lambda/^{11}$B, shows that the lifetimes and branching ratios can be used to test the effective weak Hamiltonians used in the rate calculations. 10 refs., 4 figs.

12625 (DOE/ER/03956—5) Elementary particle interactions: Progress report, October 1, 1985-September 30, 1986. Bugg, W.M.; Brau, J.E.; Condo, G.T.; Handler, T.; Hart, E.L. (Tennessee Univ., Knoxville (USA). Dept. of Physics). Oct 1986. Contract AS05-76ER03956. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003317.

It has been found that in photoproduction, where Deck effects are minimal, the A_1 mass and width is similar to that of the A_3, in direct contradiction to electron-positron collider results indicating a considerably lower A_1 mass. The reaction $\gamma p \rightarrow p(\omega\pi^0)$ at 20 GeV with a decay angular distribution study of the $(\omega\pi^0)$ state has been analyzed to demonstrate its consistency with the B(1235) J/sup P/ = 1^+. Practical high resolution holographic photography of a large bubble chamber volume was demonstrated to be achievable with efficiencies greater than 25%, giving strong support to the technical feasibility of the tau neutrino experiment. It has been decided to construct the SLD luminosity monitor using silicon diode technology, and to construct a lead liquid argon calorimeter (instead of uranium). (LEW)

12626 (DOE/ER/04449—T1) Study of the neutron-proton interaction in the 300 to 700 MeV energy region. Annual progress report (1985-1986). Northcliffe, L.C. (Texas A and M Univ., College Station (USA). Research Foundation). 1986. Contract AS05-76ER04449. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001873.

Results obtained for experiments conducted at the LAMPF are reported. All of these experiments utilize the LAMPF polarized (50%) neutron beam and hydrogen targets. Measurements are reported for spin-correlation parameters (500 to 800 MeV, 13 GeV/c, 18.5 GeV/c) and the analyzing power (800 MeV) for n-p elastic scattering. The status of earlier LAMPF experiments by this group are also included.

12627 (DOE/ER/10667—10) Experimental particle physics at the University of Pittsburgh: Progress report, April 1, 1985-March 31, 1986. Cleland, W.E.; Coon, D.D.; Engels, E. Jr.; Shepard, P.F.; Thompson, J.A. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Dec 1986. Contract AC02-80ER10667. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003878.

Progress is reported on the study of lepton production at the SPS, large p/sub T/ direct photon production at the ISR, direct photon production at the Tevatron, and the search for fractional charge particles in semiconductors. (LEW)

12628 (DOE/ER/40039—16) High Energy Physics Program: Annual report. Webb, R.C.; McIntrye, P.M.; DiBitonto, D.D. (Texas A and M Univ., College Station (USA). Dept. of Physics). Nov 1986. Contract AS05-81ER40039. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003314.

The prime focus has been work on the Collider Detector at Fermilab (CDF), where we have successfully completed the construction and installation of half of the forward/backward hadron calorimeter system in time for the coming data taking runs of CDF this winter. The second research objective has been participation in the MACRO collaboration's efforts to search for the elusive GUT magnetic monopole at the newly constructed underground laboratory at Gran Sasso in Italy. This effort is a natural continuation of the earlier work which was carried out in our own laboratory in Hockley, Texas, and involves building a large cosmic ray detector over the next several years at the Gran Sasso in Italy.

12629 (DOE/ER/40193—T2) Investigation of hadronic matter at the Fermilab Tevatron Collider: Technical progress report, [1985 November-1986 October]. Anderson E.W. (Iowa State Univ. of Science and Technology, Ames (USA)). 2 Dec 1986. Contract AC02-85ER40193. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003693.

An investigation of hadronic matter at very high energy densities is reported: experiment E-735. The present focus is a search for a quark-gluon plasma phase of matter expected to occur when temperatures of 240 MeV are achieved. Instrumentation for three unique signatures are being prepared for implementation with first operation of the Fermilab Tevatron Collider in December 1986. The projects include a 240-element trigger hodoscope array, and a segmented photon detector. The hodoscope has been constructed and is currently undergoing calibration tests. The data acquisition system to be used for E-735 has undergone several modifications in response to changing equipment schedules, and is now largely complete. The required service will be available for the data acquisition, and additional packages will be implemented throughout the experimental period. A supplemental proposal is presented to extend the overall range and strength of the group by the addition of theoretical and data analysis expertise.

12630 (DOE/ER/40194—2) [High energy physics]: Progress report. Kofler, R.R. (Massachusetts Univ., Amherst (USA). Dept. of Physics). Dec 1986. Contract AC02-85ER40194. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003778.

During calendar year 1986 the high energy physics group at the University of Massachusetts continued its study of electron-positron annihilation reactions along with the TPC collaboration at the PEP facility of the Stanford Linear Accelerator Center (SLAC). During this year the TPC detector completed its 4th year of data collection including the 2nd year of data gathering with its full momentum resolution capabilities. In addition to assisting in the data collection, the UMass group has participated in hardware monitoring and improvement efforts, and has contributed to a number of diverse data analysis projects. The TPC collaboration has continued to publish numerous analysis results and new publications from the current data sample will continue for at least several years. Continued data taking has been approved at the PEP facility with two major improvements: the PEP luminosity will be increased by a factor of 4 or more, and the TPC will be further enhanced with the addition of a vertex detector. In addition to its continuing work with the TPC collaboration the UMass group has expanded its efforts to include a participation in the SLD project at the new linear collider (SLC) facility at SLAC. This expansion of effort has been facilitated by the addition of another UMass faculty member, Stanley Hertzbach, whose full year sabbatical, beginning this fall, will be spent working full time on the SLC project at SLAC. The UMass group has joined the "beamline" subgroup of the SLD project and is working on the design of the masking which is necessary near the interaction point to shield the detector from the intense halo of synchrotron radiation that accompanies the electron and positron beams.

12631 (INIS-SU—353, pp 31-35) Determination of π^+-meson polarizability. Ajbergenov, T.A.; Baranov, P.S.; Beznisko, O.D. 1984. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780034.

Kratkie Soobshcheniya po Fizike. No. 6.

In Experimental and theoretical physics. Collection.

Measurement of differential cross section of $\gamma\,\pi^+$- scattering for $s_1 > 4\,\mu^2$ (s_1 - is the square of $\gamma\,\pi$-system total energy in c.m.s., μ - pion mass) and of scattering angle THETAsub($\gamma\,\pi$) > 100 deg as well as determination of pion polarizability is the aim of this paper. Experiment was carried out at FIAN 1.2 GeV electron synchrotron "Pakhra". Specific feature of this experiment is that recoil neutron and producted pion were detected fromone sideof primary photon beam. As a result of experimental data approximation the following value for pion compton-effect differential cross section is obtained: d σsup(ex)/dΩsub($\gamma\,\gamma$)sup(Q)=(5.4 +- 1.0) x 10^{-32} cm^2/sr at s_1=(6.5 +- 0.5) μ^2, THETAsub($\gamma\,\pi$)130 deg +- 30 deg. Born cross section corresponding to these parameters is d σsup(B)/dΩsub($\gamma\,\gamma$)sup(Q)7.9 x 10^{-32} cm^2/sr. π^+-meson electric polarizability value asub(πsup(+))=(20 +- 12) x 10sup(-43) cm^3 is obtained. Values of pion polarizability obtained by different methods are in agreement with each other within the measurement accuracy and agree with the latest theoretical values ofpion polarizability. 9 refs.; 2 figs.

12632 (ITEF—56-1984) Proton yields at angle of 132 deg for ^{6}Li, C, Cu, Pb nuclei in the π^{+-} A → pX reactions at a π-meson momentum of 1.5 GeV/c. Buklej, A.E.; Burgov, N.A.; Vlasov, M.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1984. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700376.

Energy spectra of protons escaping at angle of 132 deg +- 6 deg in inclusive π^- (^{6}Li, C, Cu, Pb) → pX, π^+ A(^{6}Li, C, Pb) → pX reactions at the incident pions momentum of 1.5 GeV/s. For the first time obtained is the indication to approximately 4% difference in value of spectra inclination of protons escaping under the action of π^-- and π^+-mesons. 4 refs.; 4 figs.

12633 (ITEP—114-1985) Searches for heavy neutrino in beta-decay. Apalikov, A.; Boris, S.; Golutvin, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700375.

The measurement of ^{35}S β-spectrum and upper limits for mixing probabilities in the neutrino mass range 5-80 keV/c were presented. 10 refs.; 3 figs.

12634 (ITP—85-53-E) Relativistic-invariant statistical theory and its application to multiple processes. Sinyukov, Yu.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700372.

The relativistic-invariant generalization of the ideal gases statistical theory is suggested. The covariant partition function method is developed. The statistical and thermodynamical properties of gases are found on any hypersurface in arbitrary inertial reference frame. The consequences of the developed theory for statistical models of hadron multiple production are discussed. 12 refs.; 1 fig.

12635 (JINR—E-1-85-415) Universality of hadron jets in soft and hard particle interactions at high energies. Baldin, A.M.; Didenko, L.A.; Grishin, V.G.; Kuznetsov, A.A.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Tbilisskij Gosudarstvennyj Univ. (USSR)). 1985. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700377.

Submitted to the journal Z. Phys., A.

The hadron jet production in soft π^-p- and cumulative π^-pC-interactions at a 40 GeV/c momentum is studied. The collective characteristics of jets and the functions of the quark and diquark fragmentation into charged pions and neutral strange particles are analysed. The results obtained are compared with analogous data for e^+e^-- and ν(anti ν)p- interactions. The hadron jet properties are also studied using relativistic invariant variables - the squared relative 4-velocities b sub(ik).-(Psub(i)/msub(i)-Psub(k)sup(2)/msub(k) (where Psub(i), Psub(k) are 4-momenta of i-th and K-th particles and msub(i), msub(k) are their masses). The results obtained show that the quark (diquark) fragmentation proceed in a similar manner in soft hadron-hadron collisions, cumulative interactions on light nuclei, in e^+e^--annihilation and deep inelastic ν(anti ν)p-scattering. 43 refs.; 24 figs.; 5 tabs.

12636 (LA-UR—86-3946) Calculation of electromagnetic observables in few-body systems. Gibson, B.F. (Los Alamos National Lab., NM (USA); Melbourne Univ., Parkville (Australia). School of Physics). Oct 1986. Contract W-7405-ENG-36. 47p. (CONF-8610185—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87002901.

From Autumn school on few-body methods; Lisbon, Portugal (13 Oct 1986).

An introduction to the calculation of electromagnetic observables in few-body systems is given by studying two examples in the trinucleon system: (1) the elastic electron scattering charge form factor in configuration space and momentum space and (2) the two-body photodisintegration of ^{3}H leading to a neutron-deuteron final state in a separable potential formalism. In the discussion of charge form factor calculations, a number of related topics are touched upon: the relation of structure in Psi to the properties of simple NN forces, the Faddeev and Schroedinger solution to the harmonic oscillator problem, the Rosenbluth formula for electron scattering from a spin-1/2 nuclear target (e.g., the proton or ^{3}H), and the charge density operator. Formulae for ^{3}He and ^{3}H charge form factors in a central force approximation are given in configuration and momentum space. The physics of these form factors is discussed in light of results from realistic nucleon-nucleon potential model calculations, including the effects of two-pion-exchange three-body force models. Topics covered are the rms charge densities, and the Coulomb energy of ^{3}He. In the discussion of the ^{3}H photodisintegration, the Siegert form of the electric dipole operator (in the long wave length limit) is derived as are the separable potential equations which describe the off-shell transition amplitudes which connect nucleon-plus-corrected-pair states. Expressions for the Born amplitudes required to complete the two-body photodisintegration amplitude calculation are given. Numerical results for a model central force problem are discussed and compared with an approximate calculation. Comparisons with ^{3}H(γ,n)d and ^{3}He(γ,p)d data are made, and the significant features of the exact theoretical calculation are outlined. 61 refs., 26 figs.

12637 (LBL—90-Rev.) A guide to data in elementary particle physics. Yost, G.P.; Rittenberg, A.; Armstrong, B.; Ferguson, M. Jr.; Levine, B.S.; Simpson, K.H.; Trippe, T.G.; Visser, M.J.; Wagman, G.S.; Wohl, C.G. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Sep 1986. Contract AC03-76SF00098. 589p. NTIS, PC A25. File Number DE87003621.

We present an indexed guide to experimental high energy physics literature for the years 1977 through 1985. While no actual data are included, approximately 9000 papers are indexed by Beam/Target/Momentum, Reaction/Momentum (including the final state), Particle, and Accelerator/Detector. All indices are cross-referenced via an ID to the paper's title and references in the ID/Reference/Title Index. Black marks (bleeder tabs) at the side of the page enable each section to be located quickly, using the Table of Contents on the back cover. The information presented in this guide is also publicly available on a regularly updated SLAC-SPIRES database called DATAGUIDE.

12638 (PB—87-116141/XAB) Bibliography of photon total cross section (attenuation coefficient) measurements 10 eV to 13.5 Gev. Hubbell, J.H.; Gerstenberg, H.M.; Saloman, E.B. (National Bureau of Standards, Washington, DC (USA). Office of Standard Reference Data). Oct 1986. 104p. (NBSIR—86/3461). NTIS, PC A06/MF A01.

The authors present a bibliography of papers reporting absolute measurements of photon (XUV, x-ray, gamma-ray, bremsstrahlung) total interaction cross sections or attenuation coefficients for the elements and some compounds. The energy range covered is from 10 eV to above 10 GeV. The papers are part of the reference collection of the National Bureau of Standards Photon and Charged Particle Data Center. They cover the period from 1907 to March 1986. Included with each reference are annotations specifying the substances studied and the duplicative references to a total of about 20,000 data points. All these data are available in machine-readable form.

12639 (SLAC-PUB—4054) A study of strange and strangeonium states produced in LASS [Large Aperture Superconducting Solenoid]. Aston, D.; Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Nagoya Univ. (Japan). Dept. of Physics; Cincinnati Univ., OH (USA); Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 1986. Contract AC03-76SF00515. 8p. (CONF-860701—65). NTIS, PC A02/MF A01. File Number DE87003669.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Results are presented from the analysis of several final states from a high-sensitivity (4 ev/nb) study of inelastic K^-p interactions at 11 GeV/c carried out in the LASS Spectrometer at SLAC. New information is reported on leading and underlying K^* states, and the strangeonium states produced by hypercharge exchange exchange are compared and contrasted with those observed in radiative decays of the J/psi. 8 refs., 15 figs.

12640 New limit on axion production in 800-GeV hadronic showers. Brown, C.N.; Cooper, W.E.; Finley, D.A.; Jonckheere, A.M.; Jostlein, H.; Kaplan, D.M.; Lederman, L.M.; Smith, S.R.; Luk, K.B.; Gray, R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review Letters;* **57**: No. 17, 2101-2104(27 Oct 1986).

A search for neutral penetrating paticles has been made by use of an 800-GeV proton beam incident on the magnetized beam dump of the E605 spectrometer. Limits on the mass and couplings of such particles are presented. A 1.8-MeV axion coupled only to e^+e^- is ruled out.

12641 Study of e^+e^- pairs in the mass range 11 to 25 GeV/c^2 at the CERN intersecting Storage Rings. Angelis, A.L.S.; Basini, G.; Besch, H.J.; Breedon, R.E.; Camilleri, L.; Chapin, T.J.; Cool, R.L.; Cox, P.T.; von Gagern, C.; Grosso-Pilcher, C.; Hanna, D.S. (CERN, Geneva, Switzerland). *Physics Letters* [*Section*] *B;* **147B**: No. 6, 472-476(15 Nov 1984). Contract AC02-81ER40033.

A sample of 58 e^+e^- events with an invariant mass greater than 11 GeV/c^2 produced in pp collisions at a center-of-mass energy of 62.3 GeV is discussed. The cross sections are presented as a function of the mass and transverse momentum. The electron pairs are produced with a mean transverse momentum of 2.50 +/- 0.25 GeV/c. 16 references, 5 figures.

12642 Charm quark production and fragmentation in e^+e^- annihilation at 29 GeV. Derrick, M.; Fernandez, E.; Fries, R.; Hyman, L.; Kooijman, P.; Loos, J.S.; Musgrave, B.; Price, L.E.; Schlereth, J.; Sugano, K.; Weiss, J.M. (Argonne National Lab., IL). *Physics Letters* [*Section*] *B;* **146B**: No. 3-4, 261-265(11 Oct 1984).

The electroweak production asymmetry and the decay fragmentation function for $e^+e^- \rightarrow$ c anti c have been measured at $\rightarrow$ s = 29 GeV using charged D* production over the full kinematic range. The data were taken at PEP using the High Resolution Spectrometer. The measured asymmetry is -0.12 +/- 0.08. The total production cross section in units of the point cross section corrected for initial state radiation is R/sub D*/ = 2.7 +/- 0.9. 14 references, 4 figures, 1 table.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 12718, 12825

12643 **(BNL—38936) Microscopic approaches to nucleon-antinucleon annihilation.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 12p. (CONF-8609163—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003234.

From International conference and symposia on unified concepts of many-body problems; Stony Brook, NY, USA (4 Sep 1986).

The problem of nucleon-antinucleon (N anti N) annihilation is discussed in terms of the underlying quark-gluon dynamics of QCD. It is shown how recently observed selection rules exert a strong constraint on the effective quark-antiquark (Q anti Q) creation/destruction operator which enters in the annihilation process. The data on two meson modes suggest that a Q anti Q operator with one gluon quantum numbers is inadequate, and that a strong coupling approach to the treatment of the gluonic degrees of freedom is more appropriate. 25 refs., 1 fig.

12644 **(DOE/ER/04928—14) Partial wave analyses of hadron scattering below 2 GeV: Progress report, May 1, 1986-December 31, 1986.** Arndt, R.A.; Roper, L.D. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jan 1987. Contract AS05-76ER04928. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003569.

The principle focus of study for the Center for Analysis of Particle Scattering (CAPS) in the Department of Physics at VPI & SU continues to be analyses of basic two-body reactions below 2 GeV. In addition to the nucleon-nucleon, pion-nucleon, and K^+-nucleon elastic systems, we have performed an extensive isobar analysis of the pion production reaction in pion-nucleon scattering. A pion photoproduction analysis is planned to start in 1987-1988. Over the last few years we have developed an extensive computer system for the rapid assimilation of new experimental measurements into the elastic scattering data bases and analyses to obtain the most recent and best two body amplitudes available. This information is distributed to the physics community through a package of interactive computer programs and data bases known as SAID.

12645 **(DOE/ER/25009—361) Baryons on the lattice: 2, Static potential.** Flower, J. (California Inst. of Tech., Pasadena (USA)). Jun 1986. Contract AC03-81ER40050;FG03-85ER25009. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003558.

The potential due to three heavy color sources is studied in Monte Carlo Lattice Gauge Theory. The string tension is consistent with that obtained in corresponding quark-antiquark calculations and also with relativised harmonic oscillator calculations. Coulombic effects are consistent with the contribution from string vibrations being small in the range x $\leqq$ .5 fm. 21 refs., 4 figs., 4 tabs.

12646 **(DOE/ER/25009—362) Baryons on the lattice: 3, Energy density.** Flower, J. (California Inst. of Tech., Pasadena (USA)). Jun 1986. Contract FG03-85ER25009. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003557.

The squared energy density in the chromoelectric and chromomagnetic fields surrounding three heavy color changes is investigated in Monte Carlo Lattice Gauge Theory. The results are consistent with the dual superconductor picture of confinement, with the confining strings lying in the 'Y' configuration. 22 refs., 4 figs., 4 tabs.

12647 **(DOE/ER/40118—T1) Particles and fields and their interactions: Progress report.** (Boston Univ., MA (USA). Dept. of Physics). 3 Dec 1986. Contract AC02-83ER40118. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003387.

The research activities undertaken concern the phenomenology and theory of elementary particle physics and pertinent questions in field theories. Efforts are directed to understanding the dynamical features of particle physics from gauge field models of electroweak and strong interactions to the unification of strong and electroweak forces, with the possible addition of gravitational forces. A portion of our future activities will focus on the interface of cosmology and particle physics.

12648 **(DOE/ER/40213—2) Theory and phenomenology of strong and weak interaction high energy physics: [Technical progress report, 5/1/86-4/30/87].** Thews, R.L. (Arizona Univ., Tucson (USA). Dept. of Physics). 29 Dec 1986. Contract FG02-85ER40213. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004010.

The research reported includes: low energy quark-hadron dynamics; quark-gluon models for hadronic interactions, decays and structure; mathematical and physical properties of nonlinear sigma models, Yang-Mills theories, and Coulomb gases, which are of interest in both particle physics and condensed matter physics; statistical and dynamical aspects of hadronic multiparticle production. 28 refs. (LEW)

12649 **(DOE/ER/40215—T4) Detecting the radiation amplitude zero in $e^{+-}p \rightarrow e^{+-}p\gamma$.** Samuel, M.A.; Reid, J. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). Oct 1986. Contract FG05-85ER40215. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003920.

Results showing the radiation amplitude zero in $e^{+-}p \rightarrow e^{+-}p\gamma$ are presented. There are two terms contributing to the differential cross section in each case. One term has the zero while the other does not. Nevertheless, there remains a sizeable dip which could be experimentally detected at HERA (DESY). The position of the dip provides a measure of the quark charges via real photons.

12650 **(DOE/ER/40215—T5) See-saw masses for quarks and leptons in an ambidextrous electroweak interaction model.** Rajpoot, S. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). Dec 1986. Contract FG05-85ER40215. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003922.

An ambidextrous electroweak interaction model with SU(2)/sub L/XSU(2)/sub R/XU(1) gauge symmetry is described in which the conventional quarks and leptons are accompanied by a set of new fermions that transform as singlets of SU(2)/sub L/XSU(2)/sub R/. The model has only two doublets of Higgs scalars. The masses of all known quarks and leptons result from the see-saw mechanism between the conventional fermions and the new "singlet" fermions. Neutrino neutral current interactions are identical to those of the standard SU(2)/sub L/XU(1) model. The singlet fermion masses lie in the 100-GeV to 1-TeV range to be probed by the oncoming accelerators of the 1990's.

12651 **(EFI—726(41)-84) Proton lifetime in SO(10) grand unification model.** Asatryan, H.M.; Ionnisyan, A.N. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700374.

A model of grand unification based on SO(10) orthogonal group is considered. They symmetry is violated to standard SU(3)sub(C) x SU(2)sub(L) x U(1)sub(Y) in two stages via the vacuum averages of the 45 and 126 Higgs fields. Using the renormgroup equations the scale Msub(X) of the SO(10) symmetry breaking and the scale Msub(R) of the left-right symmetry breaking were calculated in two-loop approximation. It has been shown that the proton lifetime in the SO(10) model can be rather large in the ramework of recent experimental restrictions on the value of Weinberg angle and agreed with available data on the proton decay

measurements. Possible limitations on the neutrino mass arising in the model were also considered. 13 refs.

12652 **(EFI—728(43)-84) Transverse momentum distribution of the three-jet event cross section in e^+e^--annihilation.** Shakhnazaryan, Yu.G. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700366.

The differential in the variables T (momentum of the most energetic parton) and x sub(perpendicular) (transverse momentum with respect to the axis T vector momentum of each of the two remaining partons) cross section of the three-jet process $e^+e^- \rightarrow q$ anti qg is calculated in the first order of QCD. The transverse momentum distribution is also found that is integrated over all T in the range of values T admissible for the three-jet event. The contribution in the mentioned distributions of the three regions, differing by the relative value of the gluon momentum, is investigated with a view to reveal the possibility of identification of quark-antiquark and gluon jets. 7 refs.; 4 figs.; 1 tab.

12653 (INIS-SU—365, pp 22-29) **Upper limits for cumulative isobars, rho-meson production cross sections determined from the analysis of inclusive spectrum deformations.** Litvinenko, A.G.; Stavinskij, V.S. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780050. (N—12-85).

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The upper limits of production cross sections of rho and Δ^{++} on nuclei are obtained for kinematic variable forbidden region for free nucleon-scattering fron the well-known inclusive production cross sections of π mesons and protons. These values are interesting for planning corresponding experiments. The maximally possible inclusive differential cross sections for production of rho and Δ^{++} are calculated. These cross sections are supposed to be described by universal dependences on cumulative number and transverse momentum obtained during experimental investigation of meson and baryon production on nuclei in cumulative region. It is shown that the inclusive spectrum of decay products decreases with the increasing cumulative number faster than the primary resonance spectrum. As a result, spectra of decay π mesons and protons contribute not more than 1 percent to the total inclusive spectra of π mesons and protons above 0.5 GeV/c momentum.

12654 **(ITF—85-51-R) High-energy hadron scattering in a dipole Pomeron model.** Vall, A.N.; Enkovskij, L.L.; Struminskij, B.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 33p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700368.

A model for elastic diffraction of hadrons with a double vacuum pole exchange is developed. Rescattering corrections are calculated within the framework of the U-matrix formalism. The connection with multiple production characteristics is studied. Experimentally measurable consequences of the model are discussed. 24 refs.; 5 figs.

12655 **(ITP—85-26-E) Dipole Pomeron in Reggeon theory with $\alpha(0) > 1$.** Martynov, E.S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700370.

The contribution that comes from nonenhanced Reggeon diagrams within the framework of a theory with the intercept of Pomeron trajectory α sub(P)(0)>1 is investigated. The asymptotic regime where σsub(tot) approximately σsub(el) approximately σsub(inel) approximately ln s is shown to be possible withint the theory. The hadrons mean multiplicity is calculated. The multipomeron interaction taken into account is shown to lead to mean multiplicity of produced particles n approximately approximately ln ^{2}s. 14 refs.; 6 figs.

12656 **(ITP—85-99-E) Hadronic total cross sections: which Pomeron do they prefer.** Kobylinsky, N.A.; Kosenko, A.I.; Martynov, E.S.; Timokhin, V.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700373.

All data on nucleon-nucleon and meson-nucleon total cross sections are analyzed in a scheme with varying Pomeron shape and standard form of secondary Reggeons. Two solutions are found which result in essentially different asymptotic behaviour, but describe equally well the data at energies attained. Two theoretical possibilities for the Pomeron are discussed: the dipole and the froissaron. 10 refs.; 7 figs.; 1 tab.

12657 **(ITP—85-122-E) Contribution of the two-pion exchange potentials to the P-odd pp-scattering asymmetry at low energies.** Musakhanov, M.M.; Podgornov, Yu.Yu. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700369.

The P-odd asymmetry Asub(pp) of the pp-scattering is calculated within the potential approach for 15 and 45 MeV taking account of the isovector 2π-exchange in additionto the rho$_0\omega$-exchanges. The corresponding 2 π-potentials areobtained with the account of Δ-isobar configurations. The main contribution of the 2π-exchange to the Asub(pp) is shown to lie in the range of larger internucleon distances than that of the rho$_0$, ω-exchange the former must be taken into account while calculating the Asub(pp). The obtained 2π-exchange contribution to the Asub(pp) is comparable with that of the rho$_0$, ω-exchange. 30 refs.; 6 figs.

12658 **(KFTI—85-11) Polarization phenomena in the heavy lepton radiative decay, tau $\rightarrow \nu+\pi+\gamma$.** Rekalo, M.P. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1984. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700367.

The Stokes parameters are found for the protons produced by the heavy lepton decay to a pion and γ-quantum, tau $\rightarrow \nu+\pi+\gamma$, in function of the vector and axial form factors of the $\pi\gamma W^{**}$ vertex (W is a virtual W-boson in the time-like transferred momentum range) as well as in function of the possible tau-lepton anomalous magnetic moment. In principle, one may determine the following combinations of the vector v(t) and axial a(t) form factors in the nonpolarized lepton decay: chemical bondα(t)chemical bond^2, chemical bondv(t)chemical bond^2, Reav *, ReV(t), Rea(t) and ImV(t) (if it is measured the P-even, T-odd linear polarization of γ-quantums which is characterized by the Stokes parameter zeta $_1$). The Ima(rt) and ImV(t) values define the dependence of the tau $\rightarrow \nu+\pi+\gamma$ decay possibility on the tau-lepton cross polarization (at the nonpolarized γ-quantum production). The dependence of decay possibility on longitudinal components of the tau-lepton polarization vector characterizes P-odd effects in the tau $\rightarrow \nu+\pi+\gamma$ decay. 24 refs.; 4 figs.

12659 **(PREPRINT—88) Example of delta-problem arising in a finite difference context: direct and inverse problem for the discrete analog of the equation Psi + upsilon Psi = sigma Psi sub gamma.** Ragnisco, O.; Santini, P.M.; Briggs, S.C.; Ablowitz, M.J. (Rome Univ. (Italy)). Dec 1985. 11p. (ETN—86-97922). NTIS, PC A02/MF A01.

The direct and inverse spectral problem for the discrete analog of the equation Psi sub xx + upsilon Psi = delta Psi gamma is solved in the framework of delta bar theory. The time evolution of the spectral data for the simplest nonlinear differential-difference equations associated to this linear problem is derived.

12660 **(SLAC-PUB—4138) Detection of Higgs bosons decaying to bottom quarks.** Gilman, F.J.; Price, L.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Argonne National Lab., IL (USA)). Nov 1986. Contract AC03-76SF00515. 3p. (ANL-HEP-CP—86-125; CONF-8606215—20). NTIS, PC A02. File Number DE87003269.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

Several developments affecting the possibility of Higgs detection are discussed. These include the level of certainty about the t quark mass, Monte Carlo programs to generate both signal and background events, and separation and/or enhancement of heavy

quark jets from jets due to light quarks or gluons, and the possibility that the neutral Higgs decay into bottom quarks might be the decay mode of choice for detecting the intermediate mass Higgs. Possible means of detection of an intermediate mass Higgs at the SSC, particularly if a prominent decay mode is to bottom quarks, are examined, using the PYTHIA Monte Carlo program to generate both signal and background events. For the signal, events were generated in which Higgs bosons are created in proton-proton collisions, with the Higgs decaying into bottom quarks. The presence of W or Z bosons, created in the same proton-proton collision, is used to enhance the likelihood of Higgs production and to reduce the potentially enormous background. It is found that the Higgs decay to bottom quarks, if important, would be more favorable for detection of the Higgs than decay to top quarks was found to be because of the smaller background. 3 refs., 4 figs. (LEW)

12661 **Neutrino counting at e^+e^- colliders and E_6 gauge theory.** Barger, V.; Deshpande, N.G.; Whisnant, K. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706; Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403; Physics Department, Florida State University, Tallahassee, Florida 32306). *Physical Review Letters;* **57**: No. 17, 2109-2111(27 Oct 1986).

We examine the effect on neutrino counting in $e^+e^- \rightarrow \nu\text{nu-bary}$ due to light right-handed neutrinos and extra gauge bosons that could occur in some superstring-inspired E_6 gauge models. The effect can be as high as $\Delta N/\text{sub } \nu/\approx 0.75$ at $\sqrt{s} = 30$ GeV, but is smaller at higher energies.

12662 **Possible manifestation of quark-gluon plasma in multiplicity distributions from high-energy reactions.** Fowler, G.N.; Friedlander, E.M.; Weiner, A.R.M.; Wilk, G. (Physics Department, University of Marburg, Federal Republic of Germany). *Physical Review Letters;* **57**: No. 17, 2119-2122(27 Oct 1986).

We show that in order to explain the observed dependence of multiplicity distributions on energy and shifts of the centers of rapidity bins it is sufficient to assume the existence of two sources. One source is concentrated at small rapidities and has properties of a thermally equilibrated system as could be expected from a quark-gluon plasma. The other one, contributing to the whole rapidity region, displays characteristics of bremsstrahlung emission.

12663 **Physics of the quark-gluon plasma.** McLerran, L. (Physics Department MS-106, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Reviews of Modern Physics;* **58**: No. 4, 1021-1064(Oct 1986).

This paper is based on a series of eleven lectures that were presented at a workshop on The Physics of the Quark-Gluon Plasma held at Hua-Zhong Normal University in Wuhan, People's Republic of China, in September 1983. The lectures were updated for publication in November 1985. They cover perturbation theory of the plasma at high temperature, as well as the nonperturbative methods and results of lattice gauge theory computations. Physical models of the confinement-deconfinement phase transition and the modes of chiral symmetry breaking are presented. The possibility that a quark-gluon plasma might be produced in ultrarelativistic nuclear collisions is briefly discussed in the introductory lecture.

12664 **Relativistic photon-Maxwellian electron cross sections.** Wienke, B.R.; Lathrop, B.L.; Devaney, J.J. (Los Alamos National Lab., Los Alamos, NM 87545). pp 977-980 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Temperature-corrected cross sections, complementing the Klein-Nishina set, are developed for astrophysical, plasma, and transport applications. The set is obtained from a nonlinear least squares fit to the exact photon-Maxwellian electron cross sections, using the static formula as the asymptotic basis. Two parameters are sufficient (two decimal places) to fit the exact cross sections over a range of 0-100 keV in electron temperature, and 0-1 MeV in incident photon energy. The fit is made to the total cross sections, yet the parameters predict both total and differential scattering cross sections well. Corresponding differential energy cross sections are less accurate. An extended fit to (just) the total cross sections, over the temperature and energy range 0-5 MeV, is also described.

6453 Particle Invariance Principles And Symmetries

12665 **World-sheet supersymmetry.** Braden, H.W.; Frampton, P.H. (Institute of Field Physics, University of North Carolina, Chapel Hill, Chapel Hill, North Carolina 27514). *Physical Review Letters;* **57**: No. 17, 2112-2114(27 Oct 1986).

For the classical nonlinear σ model on a general target manifold M, the progressive imposition of world-sheet supersymmetry (with torsion) from (1,0) to (2,2) is systematically analyzed and generalized; at each step, implications both for M and for the background gauge connection are stated. Quantum conformal invariance is then imposed. Our analysis applies to superstrings without known space-time supersymmetry.

6454 Field Theory

REFER ALSO TO CITATION(S) 12645, 12646, 12663, 12665, 12835

12666 **(CALT—68-1330) Yang-Mills vacuum: An attempt of lattice loop calculus.** Furmanski, W.; Kolawa, A. (California Inst. of Tech., Pasadena (USA)). [1985]. Contract FG03-85ER25009. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003562.

An attempt is made to derive and to solve the Schrodinger equation in the low energy region (vacuum, first excitation, etc.) of the Yang-Mills theory on the lattice. The complete orthonormal basis in the physical Hilbert space is constructed by classifying independent solutions of Gauss's law. Loops of electric flux are chosen as elementary variables. The loop space Hamiltonian is derived, an ansatz is made for the low energy wave functionals and the Schrodinger equation is solved in the (truncated) loop basis. The resulting physical picture for the Yang-Mills vacuum in the cross-over region is that of, still quite dilute, gas of fluctuating loops. Definite candidate for the confining force emerges: the repulsive non-abelian loop-loop interaction (rather weak but persistent) generates an effective external field ("external pressure") prohibiting unbounded loop size fluctuations. The negative sign (repulsion) is universal for all compact groups. Preliminary numerical results, so far mainly of illustrative character, are presented. 8 refs., 22 figs.

12667 **(ITEP—42-1985) Wess-Zumino Lagrangians in chiral models and quantization of their constants.** Krichever, I.M.; Olshanetskij, M.A.; Perelomov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700327.

A general method of constructing the Wess-Zumino-type Lagrangians is proposed. The corresponding constants are shown to be quantized. Some examples in 1d, 3d and 4d dimensions are considered. 8 refs.

12668 **(ITEP—87-1985) On quantization of supersymmetric theories.** Smilga, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700333.

A recipe to resolve ordering ambiguities in the quantum Hamiltonian of supersymmetric theories is suggested. The Weyl ordering prescription for supercharge operators should be employed to preserve SUSY algebra on the quantum level. The quantum Hamiltonian does not generally coincide with the Weyl ordered classical Hamiltonian, the difference being due to the fact that the Weyl symbol of anticommutator of supercharges does not generally coincide with the Poisson bracket of their Weyl symbols (i.e. the classical Hamiltonian). The suggested procedure is applied in the exam-

ples of N=1 and N=2 supersymmetric σ-models analyzed in the constant field limit. 16 refs.

12669 (ITEP—95-1985) Renormalizations in 1/N expansion in σ-model. Terent'ev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700328.

Renormalization of the O(N) Σ-model beyond the framework of usual perturbation theory is investigated using the 1/N expansion. The intermediate normalization mass scale μ^2 is xplicitly introduced and the problem of factorization of small ($p<\mu$) and large ($p>\mu$) momenta are discussed. The work is a preliminary step in studying the operator expansion beyond perturbation theory. 10 refs.; 2 tabs.

12670 (ITEP—100-1985) How to quantize supersymmetric theories. Smilga, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700326.

A recipe for resolving the ordering ambiguities in quantum Hamiltonians of supersymmetric theories is suggested. The Weyl ordering procedure applied to classical supercharges expressed as functions on the phase space of a classically supersymmetric system is shown to result in quantum operators which satisfy usual SUSY algebra. The quantum Hamiltonian does not always coincide with the Weyl ordered classical Hamiltonian function. The difference is due to that the Weyl symbol of the supercharge anticommutator does not coincide with the Poisson bracket of their Weyl symbols (i.e. the classical Hamiltonian). The procedure is applied to supersymmetric σ-models (both N=2 and N=1 cases are analyzed) and also to the supersymmetric SU(2) Yang-Mills theory. Only quantum mechanical systems following from field theories when fields are assumed to be independent of space coordinates are considered. For gauge theories thesuggested recipe for quantization leads to the same result as the well-known Dirac recipe. 20 refs.

12671 (ITF—85-139-R) Generalized stochastic equations in field theory. Kozhamkulov, T.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700329.

The covariant stochastic equation in curved field space is derived. It is shown, that stochastic equations for various lattice gauge theories can be obtained using this equation. The finite difference stochastic field equations of the higher orders are proposed. The simple numerical models are used to demonstrate advantages of the proposed approach over the standard Parizi-Wu method. 7 refs.

12672 (JINR—E-2-85-732) Eguchi-Hanson type metrics from harmonic superspace. Gal'perin, A.S.; Ivanov, E.; Ogievetsky, V.; Townsend, P.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). 1985. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700334.

The harmonic superspace provides a framework for constructing general hyper-Kahler metrics. The simple example of the Taub-NUT manifold was given previously. Here we show that the harmonic superspace Lagrangian Lsup(+4)=1/4[(Dsup(++)ω)sup(2)-(xisup(++)sup(2)ωsup(-2)) for a single interacting hypermultiplet describes an N=2 superssymmetric hyper-Kahler σ-model witn the d=4 Eguchi-Hanson instanton as its target manifold. The potential ω^{-2} is the unique one invariant with respect to a Pauli-Gurseylike SU(2) group. We present other harmonic superspace actions which we expect to yield some other types of hyper-Kahler metrics, including the multi-Eguchi-Hanson and Calabi ones, etc. 17 refs.

12673 (JINR—E-4-85-526) Representations which satisfy identities associated with tensor operators. Second-degree tensor operators transforming under the representations: (Λb), ($2\Lambda_3$) of so(2n,c) and ($4\Lambda_1$), ($2\Lambda_3$) of sp(2n,c). Iosifescu, M.; Scutaru, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Institutul Central de Fizica, Bucharest (Romania)). 1985. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700335.

The present work continues the determination (started insup(/6/)) of the representations p of semisimple Lie algebras L for which Tsub(σsup((2))(p)sigh-identity Tsub(σ)sup((2)) (x_1, ..., xsub(n)).=0, where Tsub(σ)sup((2)) (x_1, ..., xsub(n)) is a tensor operator transforming under a subrepresentation σ of (ad x ad)sub(s), and xsub(i) are the generators of p. For L=so(2n, c) it is proved that if σ=(Λ4), then p=(kΛ1) and that if σ=(2Λ3), then p=(Λsub(n). For L=sp(2n, c) it is proved that of σ=(4Λ1), then p=(Λ1) and if σ=(2Λ3), then there exists no solution to the equation Tsup(2)sub(2Λsub(2))(p)=0. (Λsub(i) is the highest weight of the fundamental representation (Λsub(i)) (i=1, ..., n)). 7 refs.

12674 (PUC-TN—32/84) Metastability in Field Theory and Statistical Mechanics. Carvalho, C.A. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1984. 11p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700330.

After a phase transition analysis which can occur in the framework of a scalar field theory, at finite temperature and in presence of a external field, possibles metastable situations are studied and also how is their relationship with the transitions. In both cases it is used a semiclassical approximation to the theory which, in Statistical Mechanics, corresponds to the droplet-bubble model. (L.C.).

12675 (UWThPh—86-24) Supersymmetry of the photon. Rumpf, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700331.

The supersymmetric massless states of a relativistic extension of Witten's supersymmetric quantum mechanics are shown to correspond to abelian gauge fields realized by antisymmetric tensors. The massive states, which are only partially supersymmetric, include spin-1 and spin-0 particles. In particular the Maxwell and Proca fields are obtained from N = 2 supersymmetric relativistic mechanics by first quantization in much the same way as the Dirac theory arises in the N = 1 case. The particles may be coupled supersymmetrically to external scalar and complex hermitian tensor fields. The latter reduce in special cases to the Riemannian metric of external gravitation and the Kaehler metric implied by a vector field coupling. All the couplings exhibit a quadrupole characteristics of the particles. In particular supersymmetry requires their electric charge and magnetic dipole moment to vanish, and there is no coupling to torsion in Riemann-Cartan spacetime. Quantization in external fields yields covariant generalizations of the classical tensor field equations. Finally classical equations of translational and spin motion involving only real quantities are obtained from the Heisenberg equations.

12676 (UWThPh—86-25) Sum rules in QCD and the determination of the vacuum condensates. Bertlmann, R.A. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700332.

We review QCD sum rules like the 'magic moments'. Gaussian sum rules and FESR (finite energy sum rules). A determination of vacuum condensate values within FESR is presented.

12677 Is there an upper limit to fermion masses?. Einhorn, M.B.; Goldberg, G.J. (NORDITA, Copenhagen, Denmark and Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 48109). *Physical Review Letters;* **57**: No. 17, 2115-2118(27 Oct 1986).

A fermion mass generated by spontaneous symmetry breaking is proportional to its Yukawa coupling y to a Higgs field. Like the Higgs-field self-coupling, y may well be trivial and diverge at a finite energy scale Λ/sub f/, corresponding to an upper limit on fer-

mion masses. We verify this by solving a simple model by means of a 1/N expansion. Applied to the standard model, this suggests that there is an upper limit to quark and lepton masses. These results have implications for the "decoupling" of heavy fermions and bear on the issue of whether apparently "anomalous" gauge theories can be consistently quantized.

12678 **Evidence for scaling in lattice QCD at $\beta = 5.7$.** Sexton, J.C.; Thacker, H.B. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review Letters;* **57**: No. 17, 2131-2134(27 Oct 1986).

The SU(3) deconfinement temperature is studied on asymmetric lattices as a probe of scaling. For lattices with four sites in the temperature direction (β/sub c/$\cong$5.7) we find precise agreement between the measured asymmetry dependence of the Λ parameter and that predicted by one-loop perturbation theory. The agreement holds over a large range of asymmetry ($0.65 \leq \xi \leq 1.1$) and implies that violations of perturbative scaling above $\beta \cong 5.7$ are independent of asymmetry and therefore unlikely to be lattice artifacts. This provides evidence that the coupling range 5.7approx. $<\beta$approx. $<$6.2 is a regime of nonperturbative but universal scaling.

12679 **Normal and antinormal ordering of boson operator functions.** Willis, B.L.; Zweifel, P.F. (Virginia Polytechnic Institute and State Univ., Blacksburg). *Physics Letters* [*Section*] *A;* **108A**: No. 7, 322-324(15 Apr 1985). Contract AS05-80ER10711.

It is shown that the divergences associated with antinormally ordered forms of boson operators, as discovered computationally by Baltin, is due to an unjustifiable interchange of order of summation. 9 references.

12680 **Use of compensators to break supersymmetry in an $N = 1$ supergravity theory.** Mahanthappa, K.T.; Staebler, G.M. (Imperial College, London, England). *Physics Letters* [*Section*] *B;* **146B**: No. 5, 323-327(18 Oct 1984).

The authors consider an $N = 1$ supergravity theory with multiple compensators and show that supersymmetry is broken by a solution to the equation of motion of a compensator. When a chiral scalar superfield is coupled to supergravity, the authors discuss various aspects of supersymmetry breaking and show that the super-Higgs-Kibble effect is operative. Possible applications of this mechanism of supersymmetry breaking in model building and extended supergravity theories are indicated. 12 references.

12681 **Guided random walks for solving Hamiltonian lattice gauge theories.** Chin, S.A.; Negele, J.W.; Koonin, S.E. (Univ. of California, Los Angeles). *Annals of Physics (New York);* **157**: No. 1, 140-165(1 Oct 1984). Contract AC02-76ER03069.

Motivated by developments for many-particle quantum systems, a Monte Carlo method for solving Hamiltonian lattice gauge theories without fermions is presented in which a stochastic random walk is guided by a trial wave function. To the extent that a substantial portion of the local structure of the theory can be incorporated in the trial function, the method offers significant advantages relative to existing techniques. The method is applicable to the study of SU(N) lattice gauge theories, and its utility is demonstrated by solving the compact U(1) gauge theory in three spatial dimensions. 32 references, 6 figures.

12682 **Chiral symmetry breaking with octet and sextet quarks.** Kogut, J.B.; Shigemitsu, J.; Sinclair, D.K. (Univ. of Illinois, Urbana-Champaign). *Physics Letters* [*Section*] *B;* **145B**: No. 3,4, 239-242(20 Sep 1984). Contract AC02-76ER01545;FG02-84ER45105.

The finite temperature chiral transition is studied in the quenched approximation for octet and sextet quarks. The ratios of critical temperatures are estimated to be T/sub c//sup (8)//T/sub c//sup (3)/ $\sim$ 7.5 +/- 1.5 and T/sub c//sup (6)//T/sub c//sup (3) $\sim$ 12.0 +/- 2.5. 12 references, 3 figures.

12683 **Two-loop finite supersymmetric SU_5 theory: towards a theory of fermion masses.** Jones, D.R.T.; Raby, S. (Univ. of Colorado, Boulder). *Physics Letters* [*Section*] *B;* **143B**: No. 1-2-3, 137-141(9 Aug 1984).

The authors present a realistic two-loop finite supersymmetric grand unified theory. The gauge group is SU_5 and the low energy theory includes three families of quarks and leptons with the minimal Higgs doublet content. The most important feature of the model is the non-trivial constraint of finiteness on the quark and lepton masses. The authors find sin^{2}theta/sub w/ = 0.21 and /sub b//m/sub tau/ = 1.8 (at M/sub w/) and predict a top quark mass of 155 GeV. Nucleon decay is dominated by colored Higgs triplet exchange with characteristic decay modes $p \rightarrow K^0\mu^+$, $p \rightarrow K^0$nu vector/sub μ/ and $n \rightarrow K^0$nu vector/sub μ/. 18 references.

12684 **Non-abelian isometries and dimensional reduction.** Mansouri, F.; Witten, L. (Univ. of Cincinnati, OH). *Physics Letters* [*Section*] *B;* **140B**: No. 5-6, 317-320(14 Jun 1984). Contract AC02-76ER02978.

Dimensional reduction is carried out for space-times, with or without torsion, which possess non-abelian isometries. The spectra and the equations of motion of the dimensionally reduced theory are obtained directly from the higher dimensional theory. The spectra of the reduced theories are naturally given in terms of scalar fields and antisymmetric tensor field strengths. A method of studying the dependence on the extra dimensions is suggested. 3 references.

12685 **Chiral anomaly and a class of two-loop finite supersymmetric gauge theories.** Jones, D.R.T.; Mezincescu, L. (Univ. of Colorado, Boulder). *Physics Letters* [*Section*] *B;* **138B**: No. 4, 293-295(19 Apr 1984). Contract AC02-81ER40025.

By means of the supercurrent anomaly the authors derive a formula for the two-loop β-function of the matter self-interactions in an arbitrary massless $N = 1$ supersymmetric gauge theory. As a trivial consequence the authors show that if such a theory is one-loop finite it is also two-loop finite, and the authors discuss whether this finiteness persists to all orders. 22 references.

12686 **β-function in supersymmetric Yang-Mills theory.** Jones, D.R.T.; Mezincescu, L. (Univ. of Colorado, Boulder). *Physics Letters* [*Section*] *B;* **136B**: No. 4, 242-244(8 Mar 1984).

The authors show by means of the Adler-Bardeen theorem how to calculate the two-loop β function from a one-loop calculation of the superconformal anomaly in a supersymmetric gauge theory with arbitrary superpotential. The $N = 2$ and $N = 4$ cases are also briefly discussed. 18 references.

12687 **Non perturbative anomalies in higher dimensions.** Elitzur, S.; Nair, V.P. (Institute for Advanced Study, Princeton, NJ). *Nuclear Physics;* **B243**: 205-211(1984). Contract AC02-76ER02220.

The authors study how nonperturbative anomalies can occur in dimensions higher than four and their implications on the consistency of the theory. 9 references, 1 table.

12688 **Self-similar replication approach to random-fields systems.** Shapir, Y. (Brookhaven National Lab., Upton, NY). *Journal of Physics C: Solid State Physics;* **17**: L809-L815(1984). Contract AC02-76CH00016.

Very long relaxation times are present in random-field systems near their critical points. As the correlation length grows, already above the transition, it is necessary to differentiate between the short-time (local) regime and the long-time (global) one. A self-similar replication procedure is proposed in order to separate iteratively between slow and fast modes. Recursion relations among effective exponents on successive time scales are obtained and apparent reduced dimensions, in both regimes, are deduced. For the short time behavior of Ising systems the authors find a dimensional reduction by one, both in $d = 3$ and in $d = 2$ (the lower critical dimension). The results are in agreement with the measurements of the specific heat and the correlation length performed on random

antiferromagnets by linear birefrigence and neutron scattering respectively. 22 references.

65 PHYSICS II

6510 Nuclear Physics

12689 (CONF-8610150—Summ.) Mini-proceedings of the workshop on heavy ion physics and instrumentation for a 15-Tm booster and storage ring. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 83p. NTIS, PC A05. File Number DE87002594.

From Workshop on heavy-ion physics and instrumentation for a 15-TM booster and storage ring; Oak Ridge, TN, USA (2 Oct 1986).

The goal of this workshop was to probe in depth a few of the areas of possible physics made possible by the availability of an intermediate energy heavy-ion physics facility. There was a special emphasis on physics that would be possible only with a storage/cooler ring. Topics discussed were nuclei far from stability, quantum electrodynamics, giant resonances and photonuclear reactions, and high energy gamma-ray production. Individual papers in this meeting were abstracted separately.

12690 (DOE/ER/01067—T1) Triangle Universities Nuclear Laboratory: Annual report, TUNL XXV, 1 September 1985-31 August 1986. (Triangle Universities Nuclear Lab., Durham, NC (USA)). 1986. Contract AC05-76ER01067;AS05-76ER02408;AS05-76ER03624. 223p. NTIS, PC A10/MF A01; GPO Dep. File Number DE87003327.

The varied research programs described in this report reflect a decision to devote major resources to the study of the multiple facets of nuclear structure which can be probed through light-ion and neutron induced nuclear reactions. Particular emphasis is placed on reactions induced by polarized protons, deuterons, and neutrons. A major commitment continues towards the study of the statistical properties of nuclear structure revealed by elastic and inelastic scattering experiments using ultra high resolution proton beams. A third major laboratory commitment involves measurements of fast neutron cross sections required by the Department of Energy's program for the development of controlled thermonuclear fusion. (DWL)

12691 (INIS-SU—392) Nuclear spectroscopy and nuclear structure. Summaries of reports of 36. conference. Nuclear spectroscopy in charged particle reactions. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya SSSR, Moscow; Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1986. 614p. (In Russian). (CONF-8604278—Summs.). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053.

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

The individual reports for this meeting have been abstracted separately.

12692 Nuclear data for basic and applied science. Volume 2. Young, P.G.; Brown, R.E.; Auchampaugh, G.E.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). 1730p. (CONF-850507—). Gordon and Breach, 50 West 23rd Street, New York, NY 10010.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

This book presents the papers given at a conference on nuclear data for basic and applied science. Topics considered at the conference included fast neutron interaction with niobium, new neutron cross sections for fusion materials studies, effect of fission dynamics on the spectra and multiplicities of prompt fission neutrons, and cold fragmentation in thermal neutron induced fission of /sup 235/U.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 12169, 12697

12693 Potential development of advanced power sources from current antiproton technology research. Campbell, L.J.; Holtkamp, D.B.; Holzscheiter, M.H.; Howe, S.D.; Hynes, M.V.; King, N.S.P.; Saylor, W. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 43-47 of Proceedings of the 21st intersociety energy conversion engineering conference. Washington, DC; American Chemical Society (1986). (CONF-860810—).

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Antiproton production rates have been increasing by an order of magnitude every 2.5 years. Projections based on the past 30 years of production indicate that in the next decade and beyond, antiprotons will be produced at a sufficient level for applied research in the areas of prime power and propulsion. To accomplish this level of production significant progress in accelerator technology in necessary. Increasing the production rates of antiprotons is a high priority task at facilities around the world. Rapid progress can be expected in the short term. Coupled to state-of-the-art pulsed power and RFQ decelerator technology, the storage of antiprotons in a convenient and portable device suitable for applications research in these areas can be accomplished using the well-established ion trap technology used in atomic physics. Storage of antiprotons for large scale applications requires technological developments in atomic-scale physics for which ion traps will serve as an intermediate technology providing ultra-low energy antriprotons. Antiprotons power sources offer unique advantages in many applications. To realize these applications will require a broad interdisciplinary effort in both basic and applied research.

12694 The Los Alamos National Laboratory neutron-neutron scattering program. Glasgow, D.W.; Moore, M.S.; Morgan, G.L.; King, N.S.P.; Alrick, K.R.; Shepard, M.L.; Streetman, J.R.; Hale, G.M. (Los Alamos National Lab., Los Alamos, NM). pp 913-917 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

A theoretical and experimental program is underway to determine the feasibility of a measurement of the neutron-neutron scattering cross section of 10-12% uncertainty using small-angle, low center-of-mass energy, colliding neutron beams derived from a fusion-fission nuclear source. The neutron-neutron scattering length would be inferred from the measured cross sections. The general concept of the experiments and progress are discussed.

12695 Nuclear decay data: Some applications and needs. Reich, C.W. (Idaho National Engineering Lab., EG & G Idaho, Inc., Idaho Falls, ID). pp 647-658 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Nuclear decay data have broad relevance to a number of basic scientific disciplines as well as to many areas of technology. In this paper, the authors discuss selected applications where decay data are making, or promise to make, important contributions. The following specific illustrations are discussed: the large body of precise new actinide-nuclide decay data produced through the work of the recently concluded IAEA Coordinated Research Program on the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data; the use of actinide-nuclide half-lives as reference standards in nuclear-data measurements; and the relevance of short-lived fission-product decay data to basic physics and reactor technology and some of the problems and challenges that they present to both theory and experiment.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

12696 **(BNL—38899) Future hypernuclear experiments at BNL [Brookhaven National Laboratory].** Pile, P.H. (Brookhaven National Lab., Upton, NY (USA)). Aug 1986. Contract AC02-76CH00016. 8p. (CONF-8608135—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003196.

From INS international symposium on hypernuclear physics; Tokyo, Japan (20 Aug 1986).

A review of the current and future hypernuclear physics programs at Brookhaven National Laboratory is presented. The present S = -1 and proposed S = -2 dibaryon research programs are highlighted. 24 refs., 7 figs.

12697 **(DOE/ER/40146—T1) [Medium energy physics at Syracuse University: Technical progress report].** Souder, P.A. (Syracuse Univ., NY (USA). Dept. of Physics). 9 Oct 1986. Contract FG02-84ER40146. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87000955.

The primary focus of research has been an experiment at the MIT-Bates Linear Accelerator Center to measure the spin-dependence of elastic scattering of electrons from carbon. The Syracuse University Medium Energy Physics Group is also part of a collaboration which will measure the tensor polarization of deuterons scattered by electrons. Finally, analysis has been completed for an experiment at LAMPF in which the first observation of the exotic ion $\mu^+e^-e^-$ was made. 17 refs., 18 figs., 2 tabs.

12698 (INIS-SU—365, pp 6-14) **Suppression of the annihilation less break-up processes in antiproton - ^{4}He interaction.** Batusov, Yu.A.; Bunyatov, S.A.; Nichitiu, F. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780050. (N—12-85).

In JINR rapid commutations. Collection.

Production of charged particles in the 19.6, 48.7 and 179.6 MeV antiproton-^{4}He scattering has been measured at LEAR facility at CERN using the streame chamber in magnetic field. It has been found that the multiplicity distributions of charged particles are practically independent of the antiproton incident energy. This demonstrates the strong suppression of the annihilationless break-up reactions of the (anti p, anti p') type, the cross section of which is by an order of magnitude less than the cros section of the similar reactions inproton-^{4}He scattering. 14 refs.; 1 fig.; 1 tab.

12699 **(SLAC-PUB—4134) Electrodisintegration of few body systems at SLAC and the Y scaling approach.** Meziani, Z.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1986. Contract AC03-76SF00515. 9p. (CONF-8610196—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003267.

From European workshop on few body physics; Rome, Italy (7 Oct 1986).

It is proposed that extraction of the scaling function F(y) from the transverse and longitudinal response functions in inclusive quasi-elastic electron scattering from ^{3}He and ^{4}He is a powerful method to either study the validity regime of the impulse approximation by allowing the access to the high nucleon momentum components in these nuclei, or the electromagnetic properties of bound nucleons. 19 refs., 4 figs.

12700 **Production of tritium and /sup 4/He in a large cylinder of /sup 6/LiD irradiated with 14-MeV neutrons and comparison with Monte Carlo calculations.** Goldberg, E.; Barber, R.L.; Griffith, C.M.; Nethaway, D.R.; Haight, R.C. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA). *Nuclear Science and Engineering;* **94**: No. 2, 120-135(Oct 1986). Contract W-7405-ENG-48.

A large cylindrical assembly of /sup 6/LiD was irradiated by neutrons from a high-intensity deuterium-tritium source. Small samples of /sup 6/Li, /sup 7/Li, and /sup 6/LiH, all encapsulated in lead, were positioned along the assembly axis and served as indicators for /sup 4/He and tritium production. The amount of /sup 4/He was determined by isotope dilution mass spectrometry while the tritium content of the /sup 6/LiH wafers was measured by proportional counting of gas samples. Careful comparison of the results with TART Monte Carlo calculations showed excellent agreement. For /sup 4/He generation, the experimental values were 1.01 +. 0.06 times those of the calculations, while for tritium the ratio was 1.055 +. 0.07.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

12701 **(DOE/ER/03244—130) Triple-differential cross sections of the (πi/,pp) reaction on lithium isotopes.** Rieder, R.; Barnes, P.D.; Bassalleck, B.; Eisenstein, R.A.; Franklin, G.; Grace, R.; Maher, C.; Pile, P.; Szymanski, J.; Wharton, W.R. (Carnegie-Mellon Univ., Pittsburgh, PA (USA); Kyoto Sangyo Univ. (Japan); Massachusetts Inst. of Tech., Cambridge (USA); Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center; Washington Univ., Seattle (USA)). 1985. Contract AC02-76ER03244;W-7405-ENG-36. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003380.

The (π^+,pp) reactions on ^{6}Li and ^{7}Li have been studied at T/sub π/ = 59.4 MeV with high resolution. The first triple-differential cross sections for these reactions are presented. The data are fitted to a T-matrix and compared to the $\pi^+ d \rightarrow pp$ reaction. A model in which the pion is absorbed on a $^3S_1$ (pn) pair in the lithium nucleus describes many features of the data very well. An extrapolation of our data into unmeasured regions of phase space suggests that about 60% of the pion absorption cross section on ^{6}Li at 59.4 MeV goes into the (π^+,pp) channel. One surprising feature of the data is that the ^{6}Li(π^+,pp)^{4}He (2^-) transition at 22.1 MeV excitation is strongly populated, similar to what is observed in the ^{6}Li(d,α)^{4}He reaction. This transition involves removing one nucleon from the 1p shell and one from the 1s shell. 25 refs., 15 figs., 3 tabs.

12702 **(DOE/ER/05172—0028) [Studies of heavy-ion induced reactions]: Annual progress report.** Mignerey, A.C. (Maryland Univ., College Park (USA). Dept. of Chemistry). Oct 1986. Contract AS05-76ER05172. 77p. (ORO—5172-0028). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87003914.

An experiment was performed at the Lawrence Berkeley Laboratory Bevalac, extending previous studies using inverse reactions to 50 MeV/u ^{139}La incident on targets of C and Al. Studies of excitation energy division in lower energy division in lower energy heavy-ion reactions were furthered using kinematic coincidences to measure the excitation energies of primary products in the Fe + Ho reaction at 12 MeV/u. These results will provide important systematics for comparisons with previous measurements at 9 MeV/u on the same system and at 15 MeV/u on the Fe + Fe and Fe + U systems. Also studied were different aspects of 15 MeV/u Fe-induced reactions, with experiments performed at the Oak Ridge HHIRF. The first three contributions of this report constitute a major portion of the results from this research. Finally, at the Lawrence Berkeley Laboratory Bevalac a large detector array for coincident detection of fragmentation products in heavy-ion collisions below 100 MeV/u is being built. A list of publications, personnel, and activities is provided.

12703 (INIS-SU—392, pp 158) **M1 excitations in sup(16)O.** Tkachev, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12704 (INIS-SU—392, pp 172) **Transition densities of charge in sup(16,18)O and sup(32,34)S isotopes.** Gul'karov, I.S.; Pinkus, L.D. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12705 **(JINR—E-1-85-662) Observation of anti D-mesons in nC-interactions at 40-70 GeV/c.** Aleev, A.N.; Aref'ev, V.A.; Balandin, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 8p. (CONF-850721—27). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700397.

From International Europhysics conference on high energy physics; Bari, Italy (18 Jul 1985).

The production of anti D^0 and D^- mesons has been observed in neutron carbon interactions at 40-70 GeV/c. The experiment was performed with BIS-2 the spectrometer located in the neutron beam of the Serpukhov accelerator. The signals of anti D mesons were detected in the effective mass spectra $M(K^+(890)\pi^-)$ and $M(K^+(890)\pi^-\pi^-)$. The kinematical region of the detected anti D mesons is 30 GeV/c<Psub(L)<60 GeV/c and Psub(T)<1 GeV/c. For this region the partial cross sections are σ(nC→anti D^0+X)xBR=(0.9 +- 0.3) μb and σ(nC→D^-+X)xBR=(2.1 +- 0.7) μb. The longitudinal momentum spectrum in the region x>0.5 can be described by F(x) varies as (1-x)sup(N) with Nsub(anti)=1.1 +- 0.5 +- 0.4 and Nsub(Dsup(-))=0.8 +- 0.4 +- 0.4). The transverse momentum spectra were parametrized by the exponential function dσ/dpsub(T)sup(2) varies as exp(-Bpsub(T)sup(2)) with Bsub(anti D^0)=(1.4 +- 0.7) (GeV/c)sup(-2) and Bsub(Dsup(-))=(1.7 +- 0.8) (GeV/c)sup(-2). 9 refs.; 9 figs.

12706 **(KFTI—84-1) Reaction characteristics for proton radiative capture by light nuclei.** Rutkevich, N.Ya.; Kopanets, E.G.; Storizhko, V.E.; Kachan, A.S.; Korda, L.P.; Sheptulenko, E.V.; Startseva, T.N.; Emlyaninova, V.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1984. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700398.

The structure of imaginary and real parts of the elastic hadron testify to transformation of the structure scattering amplitude at high energies is studied in the limits of the suggested model based on the modified nonelastic overlapping function. The estimates of the structure testify to transformation of the structure in differential cross section of the "dip-secondary maximum" into the "arm". The effect is observed in pp-scattering on the SPS-collider. 9 refs.; 16 figs.; 7 tabs.

12707 **Total reaction cross section for /sup 12/C on /sup 12/C, /sup 40/Ca, /sup 90/Zr, and /sup 208/Pb between 10 and 35 MeV/nucleon.** Sahm, C.H.; Murakami, T.; Cramer, J.G.; Lazzarini, A.J.; Leach, D.D.; Tieger, D.R.; Loveman, R.A.; Lynch, W.G.; Tsang, M.B.; Van der Plicht, J. (Nuclear Physics Laboratory, University of Washington, Seattle, Washington 98195). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 6, 2165-2170(Dec 1986).

Elastic scattering angular distributions for /sup 12/C on /sup 12/C, /sup 40/Ca, /sup 90/Zr, and /sup 208/Pb were measured for projectile energies between 10 and 35 MeV/nucleon. Total reaction cross sections were extracted by an optical model analysis and compared to the prediction of the Glauber model. This comparison suggests that the nucleus-nucleus total reaction cross section at intermediate and high energies is governed by the nucleon-nucleon cross section.

12708 **Helium production cross sections for 15-MeV neutrons on /sup 6/Li and /sup 7/Li.** Kneff, D.W.; Oliver, B.M.; Goldberg, E.; Haight, R.C. (Rockwell International Corp., Canoga Park, CA). *Nuclear Science and Engineering;* **94**: No. 2, 136-144(Oct 1986).

Total /sup 4/He production cross-section measurements have been made for /sup 6/Li and /sup 7/Li for 15-MeV neutrons. Isotopically enriched samples of lithium metal were comparded with an intense flux of T(d,n) neutrons from a rotating target neutron source. Following the irradiation, the accumulated /sup 4/He was determined by isotope-dilution mass spectrometry. The lithium samples and the incident neutron spectrum were accurately characterized, both by experimental methods and by calculational simulations. The measured /sup 4/He production cross sections are 0.512 +. 0.026 b for /sup 6/Li and 0.336 +. 0.016 b for /sup 7/Li, at an average neutron energy of 14.95 MeV.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

12709 **/sup 36/S(t,pγ)/sup 38/S reaction.** Olness, J.W.; Warburton, E.K.; Becker, J.A.; Decman, D.J.; Henry, E.A.; Mann, L.G.; Ussery, L. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 6, 2049-2054(Dec 1986). Contract W-7405-ENG-48;AC02-76CH00016.

The /sup 36/S(t,pγ) /sup 38/S reaction was used to populate levels in /sup 38/S up to 3-MeV excitation. A definite 2^+ assignment to the 1292-keV first-excited state was obtained from a (t,pγ) angular correlation. Doppler shift information provided lower limits of 0.45 and 0.2 ps for the mean lifetimes of the 1291→0 and 2825→1291 transitions. Evidence for a possible new level at 2805 keV was obtained from p-γ coincidence data. The known level spectrum of /sup 38/S is compared to predictions of a shell-model interaction utilizing the full sdpf model space. The E2 and M1 transition rates predicted by this calculation are also presented.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

12710 **Coupled-channel analysis of nucleon scattering from /sup 40/Ca.** Delaroche, J.P.; Honore, G.M.; Tornow, W.; Walter, R.L. (Centre d'Etudes, de Bruyeres-le-Chatel). pp 901-904 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Differential cross sections and analyzing powers for neutron scattering from /sup 40/Ca have been measured at TUNL in the 10-17 MeV energy range. These measurements and other $\sigma(\theta)$ and σ/sub T/ measurements, as well as available /sup 40/Ca+p data, have been combined together in a coupled-channel analysis in order to trace the properties (energy dependencies, spin-orbit potentials, deformation parameters) of the nucleon + /sup 40/Ca potential up to 80 MeV.

12711 **Burn-up cross sections of /sup 51/Cr, /sup 59/Fe, /sup 65/Zn, /sup 86/Rb, /sup 103/Ru.** Katcoff, S. (Brookhaven National Lab., Upton, NY 11973). pp 557-560 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Targets of Cr, Fe, Zn, Rb, and Ru were irradiated in the hydraulic tube of the Oak Ridge HFIR reactor at a neutron flux of 2.6 x 10/sup 15/ n/cm/sup 2/sec for 1 day and 20 days. The reactor burn-up cross sections (in barns) of the radioactive product nuclides are: /sup 51/Cr, <10; /sup 59/Fe, <10; /sup 65/Zn, 60+.30; /sup 86/Rb, <20; /sup 103/Ru, <20.

12712 **Isovector resonances in pion charge exchange.** Bowman, J.D. (Los Alamos National Lab., NM). pp 549-559 of Nuclear structure 1985. Broglia, R.; Hagemann, G.B.; Herskind, B. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (1985).

From Proceedings of the Niels Bohr centennial conference; Copenhagen, Denmark (20-24 May 1985).

The (π/sup +/-/, π^0) reactions as probes of isovector resonances are discussed. Experimental observation of the isovector monopole resonance is reported. Experimental results are presented for L=0, 1, and 2 isovector resonances and are compared to random-phase approximation calculations.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

12713 (INIS-SU—365, pp 15-21) **Inelastic collisions of neon-22 nuclei with nuclei in photoemulsion at 90 GeV/c momentum.** Vokalova, A.; Krasnov, S.A.; Tolstov, K.D. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780050. (N—12-85).

In JINR rapid commutations. Collection.

The experimental data obtained according to the analysis of 4303 inelastic interactions of the relativistic neon-22 nuclei with the nuclei in photoemulsion are presented. The multiplicities and angular distributions are shown as the functions of the disintegration degree of the colliding nuclei. It is shown that the same number of interacting nucleons of the projectile neon and carbon nuclei are connected with the different impact parameters with the target nucleus. 1 ref.; 7 figs.; 1 tab.

12714 **Q-value determination for the /sup 80/Kr(d,p)/sup 81/Kr reaction.** Burks, B.L.; Varner, R.L.; Ludwig, E.J. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 6, 2316-2318(Dec 1986). Contract AS05-76ER02408;AC05-84OR21400.

The ground-state Q value for the /sup 80/Kr(d,p)/sup 81/Kr reaction has been determined by extrapolating to 0.0 MeV excitation the Q values measured for nine excited states in /sup 81/Kr. (The ground state is not observed.) Peaks from the /sup 28/Si(d,p)/sup 29/Si reaction served as energy calibration points. A ground-state Q value of 5646 +- 4 keV was found for the /sup 80/Kr(d,p)/sup 81/Kr reaction. A ground-state mass excess for /sup 80/Kr of -77 898 +- 7 keV was deduced using recent /sup 81/Kr ground-state mass measurements and the /sup 80/Kr(d,p)/sup 81/Kr Q value from the present work.

12715 **Half-life of ^{60}Fe.** Kutschera, W.; Billquist, P.J.; Frekers, D.; Henning, W.; Jensen, K.J.; Xiuzeng, M.A.; Pardo, R.; Paul, M.; Rehm, K.E.; Smither, R.K.; Yntema, J.L. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **B5**: 430-435(1984). Contract W-31-109-ENG-38.

The half-life of ^{60}Fe has been measured to be T/sub 1/2/ = (1.49 +/- 0.27) x 10^6 a, significantly longer than the one previous measurement of Roy and Kohman which reported a value of 3 x 10^5 a uncertain by a factor of 3. The present value was obtained from measurements of specific activity and radioisotope concentration in a material produced by spallation of copper with 191 MeV protons. ^{60}Fe/Fe ratios in the range of 10^{-8} were measured with the Argonne FN tandem-superconducting linear accelerator system in conjunction with an Enge split-pole spectrograph. The specific activity of ^{60}Fe in Fe was measured through the grow-in of the 1.332 MeV gamma-ray line of the ^{60}Co daughter activity. 14 references, 5 figures, 1 table.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

12716 **(FEI—1603) Double differential cross sections of neutron emission from the ^{93}Nb(n,xn) reaction at the initial neutron energy of 20.1 MeV.** Lovchikova, G.N.; Polyakov, A.V.; Sal'nikov, O.A.; Simakov, S.P.; Sukhikh, S.Eh.; Trufanov, A.M.; Shmidt, D.; Shtrajl', T. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.; Technische Univ., Dresden (German Democratic Republic)). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700399.

Spectra of neutron emission from the ^{93}Nb(n, xn) reaction at 30, 45, 60, 90, 120, 135 deg angles at 20.1 MeV initial neutron energy have been measured. Double differential cross sections of neutron emission have been performed. Angular neutron distributions from the ^{93}Nb(n, xn) reaction are given. 6 refs.; 4 figs.

12717 (INIS-SU—392, pp 99-100) **Investigation of γ-radiation from the sup(128)(n,n'γ) reaction.** Govor, L.I.; Demidov, A.M.; Mikhajlov, I.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12718 **(JINR—E-1-85-231) Experimental investigations of the particle production process at the stage before the decay of resonances.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700400.

Process of particle production in its initial stage of development was studied with the help of target nucleus applied as a precision indicator of this process properties - within the time range less than 10sup(-22) s and within the space regions less than 10sup(-12) sm. In collisions of hadrons with nucleous, in particular in collisions of nucleons with nucleons,particle production occurs through intermediate objects in two-particle endoenergic reactions of the $2 \rightarrow 2$ type. The intermediate objects decay into usually observed resonances and particles. 60 refs.; 5 figs.

12719 **(JINR—E-3-85-226) Differential elastic scattering cross sections of cadmium isotopes and p-neutron strength functions in the range $50 < A < 130$.** Popov, A.B.; Samosvat, G.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1985. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700401.

Submitted to the International conference on Nuclear Data for Basic and Applied Scince (Santa Fe, May 13 - 17, 1985).

The measurements are being carried out on the IBR-30 pulsed reactor of angle distributions of neutrons with energies up to 400 keV elastically scattered by the nuclei in the 3p-maximum of neutron strength function. The experimental data on cross section parameters were obtained for the sup(106)Cd, sup(108)Cd, sup(110)Cd, sup(112)Cd and sup(116)Cd nuclei. The strength functions and potential scattering parameters S^0, Ssub(1/2)sup(1), Ssub(3/2)sup(1), Rsub(0)sup(infinity) and Rsub(1)sup(infinity) were determined. The paper also includes data on Ssub(1/2)sup(1) and Ssub(3/2)sup(1) obtained for other nuclei in the range $50 < A < 130$. The spin-orbital splitting in p-neutton strength functions is demonstrated. 5 refs.

12720 **(JINR—R-1-85-590) Study on 7.3 GeV deuteron interaction with the ^{93}Nb, ^{159}Tb, ^{202}Pb, sup(207,2)Pb and ^{209}Bi nuclei.** Buttsev, V.S.; Buttseva, G.L.; Kostin, V.Ya.; Migalenya, V.Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700402.

Submitted to the journal Yad. Fiz. .

The results of investigation of 7.3 GeV deuteron interactions with niobium, terbium, lead and bismuth nuclei are presented. The production cross sections of residual nuclei in a wide mass number range of $24 <= A <= 92$ for sup(93)Nb target, $24 <= A <= 157$ for sup(159)Tb target, $24 <= A <= 206$ for sup(202, 207)Pb target and $24 <= A <= 206$ for ^{209}Bi target respectively have been determined for *g-ray yield of producted nuclides. For the ^{86}Y, ^{87}Y, ^{93}Tc, ^{94}Tc, ^{104}Ce and ^{196}Tl isotopes the isomeric ratios (^{9} sub(m)/^{9} sub(g)) have been determined. They are compared with those measured in reactions induced by protons, *a-particles and ^{12}C ions. 20 refs.; 3 figs.; 7 tabs.

12721 **(JINR—R-3-85-451) Study on the ^{149}Sm(n,γα) reaction on thermal neutrons and estimation of radiative strength functions of primary soft γ-transitions.** Vacik, J.; Gnatovic, V.; Kvitek, J.; Cervena, J.; Jahoda, L.; Vtyurin, V.A.; Popov, Yu.P.; Phuang Van Duan. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700403.

The $^{149}Sm(n, \alpha)^{146}Nd$ and $^{149}Sm(n, \gamma\alpha)^{146}Nd$ reactions on thermal neutrons have been measured. The cross sections of seven partial α-transitions to the ground and excited states of ^{146}Nd daughter nucleus have been obtained. The cross section of the (n, $\alpha\alpha$) reaction turned out to be equal to (3.5 +- 0.7) x 10^{-3} b. The radiation strength functions of the primary soft γ-transitions are estimated under assumption of pure M1-transitions Ssup(cc) (M1) < 2.5 x 10^{-8} [MeV^{-3}] and of pure E1 transitions Ssup(cc)(E1) < 4 x 10^{-8} MeV. The Ssup(cc)(E1) estimate is compared using the known models for the giant dipole resonance with the photonuclear data extrapolation. The known models are shown to be not in contradiction with the obtained data. 15 refs.; 2figs.; 4 tabs.

12722 **(UCRL—95092) Example of a U(5) nucleus.** Aprahamian, A. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 6p. (CONF-8606130—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002160.

From International conference on nuclear structure, reactions, and symmetries; Dubrovnik, Yugoslavia (5 Jun 1986).

Evidence is shown for the observation of five-closely spaced states in ^{110}Cd with a centroid at 1989 keV which may represent the first identification of all five members of the three-phonon quintuplet. 11 refs., 2 figs.

12723 **Fission following fusion of Ni+Sn.** Lesko, K.T.; Henning, W.; Rehm, K.E.; Rosner, G.; Schiffer, J.P.; Stephans, G.S.F.; Zeidman, B.; Freeman, W.S. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 6, 2155-2164(Dec 1986). Contract W-31-109-ENG-38.

Excitation functions for fission were measured for /sup 58,64/Ni beams incident on the even /sup 112//sup —//sup 124/ Sn targets at energies extending from well below to about 1.5 times the Coulomb barrier. Fission was identified by kinematic coincidence between fission fragments. Angle integrated fission cross sections were obtained from angular distributions taken at several energies for all systems. From these and the previously measured cross sections for evaporation residues, we obtain the total fusion cross sections and fission probabilities over the energy range 150 approx. <E/sub c.m./approx. <240 MeV. The competition between particle evaporation and fission in the compound nuclei is compared to statistical model calculations. A good description of the data for all 14 systems is achieved with the use of a single set of parameters. The model includes fission barriers with finite range and nuclear diffuseness effects, and partial-wave distributions for fusion that are qualitatively consistent with those from microscopic reaction model calculations. The fusion excitation functions are analyzed in terms of the dynamical fusion model of Swiatecki et al. Within this model we extract new values for the "extra-push" parameters.

12724 **Level structure of /sup 148/Ba: A test of the N/sub p/N/sub n/ scheme far off stability.** Hill, J.C.; Wohn, F.K.; Leininger, K.; Winger, J.A.; Nieland, M.E.; Gill, R.L.; Piotrowski, A.; Petry, R.F.; Goulden, J.D. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 6, 2312-2315(Dec 1986). Contract W-7405-ENG-82;AC02-76CH00016.

The deformed nucleus /sup 148/Ba (populated in /sup 148/Cs decay) is the heaviest Z = 56 and the lightest N = 92 nucleus known; thus its levels are extrapolations of both Z and N systematics. Values for $E(2_1^+)$, $E(4_1^+)/E(2_1^+)$, and $E(2_2^+)$ are in excellent agreement with interpolative predictions from systematics of the valence-nucleon product N/sub p/N/sub n/.

12725 **Absolute measurements of the /sup 115/In(n,γ)/sup 116m1/In cross section for fast neutrons.** Grady, D.J.; Knoll, G.F.; Robertson, J.C. (Univ. of Michigan, Dept. of Nuclear Engineering, Ann Arbor, MI). *Nuclear Science and Engineering;* **94**: No. 3, 227-232(Nov 1986).

The neutron capture cross section in /sup 115/In leading to the 54.12 min isomeric state (m/sub 1/) in /sup 116/In has been absolutely determined at neutron energies of 23,265, and 964 keV. These energies are the median neutron energies of the three photoneutron sources, Sb-Be, Na-D, and Na-Be, applied in this work. The measurements are independent of other cross-section data except for corrections amounting to <10%. Reaction rates were determined by beta counting of the /sup 116mI/In decay activity using a 4π gas flow proportional counter. Detector efficiency was measured using 4π beta-gamma coincidence counting techniques, incorporating the foil absorber method of efficiency extrapolation for correction of complex decay scheme effects. Photoneutron source emission rates were determined by indirect comparison with the U.S. National Bureau of Standards NBS-II standard source in the University of Michigan Manganese Bath. The normalized scalar flux was calculated from the neutron emission angular distribution results of a Monte Carlo computer program used to model neutron and gamma transport in the source. Correction factors were applied related to competing reactions, neutron scattering from experiment components, background from room-return neutrons, and differences in the energy spectra of the neutron sources. The absolute cross-section values obtained for the /sup 115/In(n,γ)/sup 116mI/In reaction were 588 +. 11, 196 +. 4, and 203 +. 4 mb at 23, 265, and 964 keV, respectively.

12726 **Angular-distribution neutron-emission spectra of niobium following bombardment by fast neutrons.** Guenther, P.T.; Smith, A.B. (Argonne National Lab., Argonne, IL). pp 955-958 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Neutron-emission spectra at ten angles between 20 and 160 degrees and incident neutron energies of 5.9, 7.1 and 8.4 MeV were measured relative to the neutron field emitted after spontaneous fission of /sup 252/Cf. The angular distribution of inelastically scattered neutrons appears to be essentially isotropic where it can be separated from the dominant elastic scattering peak. Above an excitation energy of 4 MeV the spectra are well described by a Maxwellian temperature distribution.

12727 **Nuclear data for production of /sup 117m/Sn for biomedical application.** Mausner, L.F.; Mirzadeh, S.; Ward, T.E. (Medical Dept., Brookhaven National Lab., Upton, NY). pp 733-737 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The /sup 117m/Sn(4+)DTPA has been shown to have high uptake in cortical bone with negligible soft-tissue deposition. The long half-life (14 d) of /sup 117m/Sn and its emission of abundant short-range Auger and conversion electrons, make /sup 117m/Sn(4+)DTPA an attractive therapeutic agent for bone tumors. The necessary nuclear data for production of clinical quantities of /sup 117m/Sn using Sb(p,2pxn) reactions at BLIP was obtained. The excitation functions for /sup 121/Sb(p,2p3n) and /sup 123/Sb(p,2p5n) reactions in the regions of 43 ≦E/sub p/≦60 MeV were measured and compared with predicted values obtained from semi-empirical formulae. /sup 117m/Sn is routinely produced at ORNL by thermal neutron activation of /sup 116/Sn. The authors have investigated the possibility of improving the specific activity of the reactor-produced /sup 117m/Sn by irradiating enriched /sup 116/Sn and /sup 117/Sn in the core of the HFBR. The results indicate that, due to a strong absorption resonance at E/sub n/≅110 eV, better specific activity for reactor-produced /sup 117m/Sn can be obtained by irradiating natural tin in the core of a reactor.

12728 **Accurate determination of the parameters of the 292.4-eV resonance of /sup 91/Zr and the 301.1-eV resonance of /sup 96/Zr.** Salah, M.M.; Harvey, J.A.; Hill, N.W.; Hussein, A.Z.; Perey, F.G. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 593-596 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

High-resolution transmission measurements of zirconium metal samples have been carried out at ORELA using the 80-m flight path and an improved /sup 6/Li-glass scintillation neutron detector. Four different thicknesses of the pure zirconium metal and one sample of zircalloy were used in four separate experiments. The transmission data for these samples were measured at room temperature, and one sample was cooled to liquid nitrogen temperature. These data were analyzed using the multilevel R-matrix computer code SAMMY.

12729 **Deformation in odd-mass nuclei near A ~100: one- and three-quasiparticle Nilsson states in $_{39}{}^{99}Y_{60}$.** Meyer, R.A.; Monnand, E.; Pinston, J.A.; Schussler, F.; Ragnarsson, I.; Pfeiffer, B.; Lawin, H.; Lhersonneau, G.; Seo, T.; Sistemich, K. (Kernforschungsanlage Juelich, West Germany). *Nuclear Physics* [*Section*] *A;* **A439**: 510-534(1985).

The deexcitation of the 8.6 μs isomer of $_{39}{}^{99}Y$ has been studied using γ-ray spectroscopy techniques at LOHENGRIN and JOSEF. The resultant level scheme is analyzed within the framework of the particle-rotor coupling model. The ground-state band, to spin 19+/2, is found to have band properties consistent with a π[422 5/2] Nilsson assignment. The 8.6 μs isomer and a side band with a band-head half-life of 1.4 ns are found to have J/sup π/ values of 17+/2 and 11+/2, respectively. Their properties are consistent with a {π[422 5/2] nu[411 3/2]nu[404 9/2]} assignment. Some evidence is given for the dominance of the nu nu interaction over the πnu interaction in these three-quasiparticle partners. 29 references, 14 figures, 4 tables.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

12730 (INIS-SU—392, pp 129) **Internal conversion electrons from the sup(179)Hf(n,γ) reaction.** Rodionov, A.A.; Sakharov, S.L.; Khazov, Yu.L. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12731 (INIS-SU—392, pp 130-131) **Sup(180)Hf excited states.** Grigor'ev, E.P.; Ievlev, S.M.; Kondurov, I.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12732 **(JINR—R-6-85-211) Separation and identification of the short-lived isotopes of tungsten from products of the $^{154}Gd + {}^{20}Ne$ reaction.** Brukhertzajfer, Kh.; Ajkhler, B.; Ehsteves, Kh.; Kruz, T.; Vill, Eh.; Zlokazov, V.B.; Portillo, R. del; Ryudiger, Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions; Akademie der Wissenschaften der DDR, Berlin-Buch. Zentralinstitut fuer Isotopen- und Strahlenforschung). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700404.

Submitted to the journal Sov. Radioch. .

The products of heavy ion reactions induced by bombarding ^{154}Gd with 149 MeV and 160 MeV ^{20}Ne ions were chemically separated by cation exchange and investigated by γ-spectrometry. In the W-fraction the new isotopes ^{169}W and ^{169}W were identified. Their half-lives have been found to be 49 +- 7 s and 55 +- 10 s, respectively. The most intensive γ-lines have been assigned to these isotopes. 8 refs.; 5 figs.; 1 tab.

12733 **(LAFI—071) Sup(153,155)Eu level structure according to the deformed nuclei models.** Guseva, T.V.; Tambergs, J.J.; Bondarenko, V.A. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1984. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700405.

The energy level structure of transitional deformation region odd nuclei of sup(153, 155)Eu has been studies in terms of several nuclear models. The energy-level and γ-transition probability calculation according to the nonadiabatic rotational model, as well as the cranking shell model analysis indicate the strong collectivisation of low-lying states. The results of sub (153, 155)Eu energy-level structure calculations on the basis of single-qasiparticle-rotation-vibration model are presented. 22 refs.; 11 tabs.

12734 **Search for the beta decay of /sup 180/Lu to /sup 180/Hf/sup m/.** Kellogg, S.E.; Norman, E.B. (Nuclear Physics Laboratory, University of Washington, Seattle, Washington 98195). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2248-2255(Dec 1986). Contract AC06-81ER40048;AC03-76SF00098.

The t/sub 1/2/ = 5.7 min /sup 180/Lu isotope was produced in the /sup 180/Hf(n,p) reaction and its subsequent β decay back to /sup 180/Hf was studied with a Ge(Li) spectrometer. A radiochemical technique was used to measure the fractional population of the I/sup π/, K = (8⁻,8) isomer in /sup 180/Hf to be f/sub m/ = 0.005 +- 0.018X The limit on f/sub m/ is shown to be too small to account for the nucleosynthesis of /sup 180/Ta/sup m/ in the r process. The possible existence of a high-spin isomer in /sup 180/Lu and its astrophysical consequences are discussed.

12735 **Isomeric levels in /sup 180/Lu and the nucleosynthesis of /sup 180/Ta/sup m/.** Lesko, K.T.; Norman, E.B.; Moltz, D.M.; Larimer, R.M.; Crane, S.G.; Kellogg, S.E. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2256-2260(Dec 1986). Contract AC03-76SF00098;AC06-81ER40048.

Searches have been made for short-lived isomers in /sup 180/Lu suggested by the preceding paper. Samples of /sup 180/Lu were produced via the /sup 180/Hf(n,p) reaction. Evidence for decay of a /sup 180/Lu isomer was sought by examining the decay curves of the known /sup 180/Lu and /sup 180/Hf/sup m/ delayed γ rays, and by searching for previously unidentified delayed γ rays. No evidence for a /sup 180/Lu isomer was observed for half-lives between 10 and 300 sec. The relevance of these observations for understanding the nucleosynthesis of /sup 180/Ta/sup m/ is discussed.

12736 **Linear momentum transfer in 292-MeV ^{20}Ne-induced fission of ^{165}Ho, ^{181}Ta, ^{197}Au, ^{209}Bi, and ^{238}U.** Tubbs, L.E.; Birkelund, J.R.; Huizenga, J.R.; Hilscher, D.; Jahnke, U.; Rossner, H.; Gebauer, B. (Univ. of Rochester, NY). *Physical Review* [*Section*] *C: Nuclear Physics;* **32**: No. 1, 214-221(Jul 1985). Contract AC02-76ER03496.

Angular correlations of fragments both in and out of the reaction plane from 292-MeV ^{20}Ne-induced fission of ^{165}Ho, ^{181}Ta, ^{197}Au, ^{209}Bi, and ^{238}U have been measured. The correlated data have been evaluated in terms of a full linear momentum transfer component and less than full linear momentum components. The method of evaluation has also been applied to other available data for ^{16}O- and ^{20}Ne-induced reactions. The maximum angular momentum l/sub FLMT/ associated with full linear momentum transfer for the systems analyzed agrees with the predictions of a classical dynamical model based on the proximity nuclear potential and one-body nuclear friction. Because of projectile breakup, the angular momentum distribution in the composite nucleus is markedly distorted from the (2l + 1) distribution expected for full linear momentum transfer.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

12737 (INIS-SU—392, pp 139) **Two-phonon states in a sup(208)Pb nucleus.** Nikolaeva, R. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12738 (INIS-SU—392, pp 134) **Disappearance of proton magic gap for neutron-deficient Pb isotopes.** Vakhtel', V.M.; Golovkov, N.A.; Gromov, K.Ya. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12739 (INIS-SU—392, pp 135) **Gamma spectrum of sup(191)Ir in the (n,N'γ) reaction.** Prokof'ev, P.T.; Rezvaya, G.L.; Simonova, L.I. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12740 (INIS-SU—392, pp 137) **Determination of relative probability of K capture on the 688.7 keV level in sup(196)Pt.** Begzhanov, R.B.; Gladyshev, D.A.; Mirakhmedov, Sh.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12741 (INIS-SU—392, pp 138) **Determinaton of the sup(204)At beta decay energy.** Veselov, G.V.; Mezilev, K.A.; Nozhkov, Yu.N. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12742 **318 and 800 MeV (p,xn) cross sections.** Meier, M.M.; Holtkamp, D.B.; Morgan, G.L.; Robinson, H.; Russell, G.J.; Whitaker, E.R.; Amian, W.; Paul, N. (Los Alamos National Lab., Box 1663, Los Alamos, NM 87545). pp 1415-1418 of Nuclear data for basic and applied science. Volume 2. Young, P.G.; Brown, R.E.; Auchampaugh, G.E.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Neutron yields from proton bombardment of elemental Pb and depleted U have been measured at bombarding energies of 318 and 800 MeV. Additionally, at 800 MeV, data were obtained for Al and C. The data were obtained at angles/flight-paths of 7.5deg/30m and 30deg/40m and were collected in two parameter histograms of time-of-flight and pulse-height in order to select detector biases in the analysis and to permit comparison of calculated and experimental pulse height spectra in the calculation of detector efficiency. The data have been reduced to absolute double-differential cross sections and are in good agreement with INC calculations at 800 MeV, but exceed calculation by a factor of three at the lower energy.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

12743 (INIS-SU—365, pp 30-34) **Extreme asymmetric fission of nuclei produced in thorium bombarding by alpha particles and deuterons.** Oganesyan, Yu.Ts.; Gehrbish, Sh.; Lobanov, Yu.V.; Korotkin, Yu.S.; Yussonua, M. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780050. (N—12-85).

In JINR rapid commutations. Collection.

The experiments describe an emission of heavy clusters from excited ^{234}Pa and ^{236}U nuclei, which are produced in bombarding ^{232}Th targets by deuterons and α particles with 17 and 35 MeV energies, respectively. It is shown that the nuclide with mass A=24 emitted with approximately 2 microbarn cross section and the nuclide with mass A=28 were not observed and the cross section was estimated to be lower than 0.1 microbarn. For its heavy fragments the upper level of cross section is obtained from 3 x 10sup(-2) to 3 x 10sup(-4) microbarn. The results of experiments are interpreted as ternary fission with the emission of heavy cluster A=24, while the limit for probability of extreme asymmetric binary fission GITAsub(clus.)/GITAsub(tot.) <= 3 x 10sup(-10) was determined. 11 refs.; 1 tab.; 1 fig.

12744 (INIS-SU—392, pp 140) **Estimation of half-life values of actinide radionuclides.** Chechev, V.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12745 (INIS-SU—392, pp 141) **Intensity of the sup(235)Np α-decay.** Ageev, V.A.; Belyaev, B.N.; Golovnya, V.Ya. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12746 (INIS-SU—392, pp 142) **Study on the characteristics of strongly deformed excited states of heavy nuclei by the shadow method.** Grusha, O.V.; Melikov, Yu.M.; Platonov, S.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12747 (INIS-SU—392, pp 143) **Measurement of absolute intensity of 74.67 keV gamma radiation from the sup(243)Am decay.** Amatuni, E.N.; Gejdel'man, A.M.; Egorov, Yu.S.; Krylov, E.G.; Chereshkevich, Yu.L. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12748 **Search for correlated narrow-peak structure in the two-photon spectrum from 6-MeV/nucleon U+Th collisions.** Meyerhof, W.E.; Molitoris, J.D.; Danzmann, K.; Spooner, D.W.; Stephens, F.S.; Diamond, R.M.; Beck, E.; Schaefer, A.; Mueller, B. (Department of Physics, Stanford University, Stanford, California 94305). *Physical Review Letters;* **57**: No. 17, 2139-2142(27 Oct 1986).

We have searched for 180° (c.m.) correlated equal-energy two-photon decays produced in 6-MeV/nucleon U+Th collisions. In the summed-energy region between 1.5 and 1.8 MeV, we set an upper limit of 3 x 10/sup -10/ decays per projectile for the yield integrated over a target thickness of 3.6 mg/cm², which corresponds to a cross section of 3 x 10/sup -29/ cm² averaged over the target. This can be compared to a production cross section of (1-2) x 10/sup -28/ cm², averaged over a target thickness of 0.3—0.6 mg/cm² found by others for correlated electron-positron pairs in the same reaction.

12749 **Neutron total cross section of /sup 240/Pu below 6 eV and the parameters of the 1.056-eV resonance.** Spencer, R.R.; Harvey, J.A.; Hill, N.W.; Weston, L.W. (Oak Ridge National Lab., Oak Ridge, TN). pp 581-584 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Measurements of the low-energy neutron transmission of five different /sup 240/Pu samples have been made using the Oak Ridge Electron Linear Accelerator (ORELA) pulsed-neutron source and the time-of-flight technique in an attempt to resolve discrepancies between the evaluated low-energy cross section of this nuclide and the observed production of heavier Pu isotopes in light-water reactors (LWRs). Three "thin" samples consisting of Pu metal foils containing 0.726 at % /sup 240/Pu were measured above 0.4 eV in order to derive the parameters of the 1.056-eV resonance, which is

responsible for most of the observed 2200-m/s total cross section. Two "thick" samples of 99.97 at % /sup 240/Pu metal were measured from 0.003 eV to about 6 eV to obtain the 2200-m/s cross section and the cross-section shape in the low-energy region. A consistent set of resonance parameters was derived from the above data sets.

12750 **Fission channel analysis for /sup 232/Th(n,f).** Becker, J.A.; Bauer, R.W. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 349-352 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Angular distributions of fission fragments produced in the / sup 232/Th(n,f) reaction have been measured in 40-keV intervals. A simplified reaction model was adopted, and a channel analysis done for 0.72 ≦ E/sub n/ (MeV) ≦ 4.5 MeV. An anomaly at E/sub n/ = 2.98 MeV suggests that K remains a good quantum number some 2 MeV above the fission threshold. The percentage contribution to the cross section of K = 3/2 states for incident neutron energies between 1.1 and 1.3 MeV is larger than previously thought.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 11313, 12575, 12632, 12690, 12700, 12708, 12710, 12894

12751 **(AD-A—172675/1/XAB) Coherent scattering of light by nuclear spins. Final report.** Weber, J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1 Jun 1986. 44p. NTIS, PC A03/MF A01.

A new kind of coherent interaction is possible for strongly coupled scatterers. The general theory is presented and applied to the coherent absorption of light by an ensemble of coupled nuclei, with polarized spins. Three kinds of experiments have been carried out, in which the coupling of scatterers with each other is important. These are: a) low energy antineutrinos interacting with nuclei of a solid; b) Raman scattering of light by electrons in a thin conducting film on the surface of polarized dielectric; and c) interaction of light with polarized nuclei of a crystal. For a) the theory is the interaction of two current densities and the lowest-order process is antineutrino scattering, b) is a scattering process described by the interaction of light with electrons, and c) is an absorption process described by the interaction of light with magnetic moments. All of these processes may have total cross sections orders greater than the corresponding ones for scatterers that are not tightly bound. This appears true for all tightly bound scatterer interactions.

12752 **(BNL—38864) Dynamical symmetries in nuclear structure.** Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 28p. (CONF-8610110—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE87003236.

From 15. international colloquium on group theoretical methods in physics; Philadelphia, PA, USA (20 Oct 1986).

In recent years the concept of dynamical symmetries in nuclei has witnessed a renaissance of interest and activity. Much of this work has been developed in the context of the Interacting Boson Approximation (or IBA) model. The appearance and properties of dynamical symmetries in nuclei will be reviewed, with emphasis on their characteristic signatures and on the role of the proton-neutron interaction in their formation, systematics and evolution. 36 refs., 20 figs.

12753 (CONF-860270—, pp 139-143) **Percolation description of nuclear fragmentation.** Bauer, W.; Mosel, U.; Post, U. (Michigan State Univ., East Lansing). Apr 1986. NTIS, PC A08/MF A01. File Number DE86009123.

From 4. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (24 Feb 1986).

The authors have introduced a statistical model of high-energy proton-induced fragmentation reactions based on bond-percolation theory. Using only a few conservation laws (charge, baryon number, total momentum and energy) and an extremely simplified two-body short-range interaction, it can reproduce a surprising amount of experimental data. Based on the results of the authors calculations they conclude: multifragmentation of the target in high-energy proton-induced collisions is a volume and not surface dominated phenomenon. The decay of the spectator matter is happening simultaneously rather than sequentially. The data assembled so far are not a unique signature of a liquid-gas phase transition of nuclear matter.

12754 (CONF-860270—, pp 155-158) **Baryon recoil and the fragmentation regions in ultra-relativistic nuclear collisions.** Csernai, L.P.; Gyulassy, M. (Lawrence Berkeley Lab., CA). Apr 1986. NTIS, PC A08/MF A01. File Number DE86009123.

From 4. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (24 Feb 1986).

The purpose of this paper is to reinvestigate the description of the fragmentation regions of ultrarelativistic nuclear collisions. Also, the authors update the estimates of energy density reached by incorporating recent nuclear stopping power results. They find that most of the discrepancy between kinetic and hydrodynamic estimates resulted from the lack of exact baryon conservation in the hydrodynamic formulation. They formulate a new hydrodynamic model preserving the continuity equation in a way that nevertheless allows them to incorporate large baryon recoil observed empirically. This model leads to significantly higher energy densities than even the earliest estimates suggested. Therefore, the prospects for studying high baryon density plasmas look better than ever.

12755 (CONF-860270—, pp 159-162) **Dilepton emission and the QCD phase transition in ultrarelativistic nuclear collisions.** Kajantie, K.; Kapusta, J.; McLerran, L.; Mekjian, A. (Univ. of Helsinki, Finland). Apr 1986. NTIS, PC A08/MF A01. File Number DE86009123.

From 4. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (24 Feb 1986).

A proposed signal for the formation of quark-gluon plasma is the emission of lepton pairs via quark-antiquark annihilation in the plasma. Since the produced leptons do not interact strongly with the quark-gluon plasma or with the final hadronized matter they will escape from the system to provide information on the early high temperature epoch of the nucleus-nucleus collision. Since the authors are here only interested in the central rapidity region they shall use Bjorken's longitudinal hydrodynamic model for the space-time evolution of the produced matter to compute some properties of dilepton emission.

12756 **(DOE/ER/05126—302) Relation of non-relativistic methods to nuclear physics.** Redish, E.F. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 24 Aug 1986. Contract AS05-76ER05126. 8p. (ORO—5126-302; CONF-860832—9). NTIS, PC A02. File Number DE87002267.

From 11. international conference on few-body systems in particle and nuclear physics; Tokyo, Japan (24 Aug 1986).

The non-relativistic nucleon-only (NRNO) formalism considers nuclear systems to be composed of nucleons described by two-component spinors and dynamics described by a hamiltonian consisting of non-relativistic kinetic energies plus two-body energy-independent potentials. This formalism is considered as a traditional framework for studying nuclear systems. In light of the development of alternative frameworks and the process of reconsidering the fundamental degrees of freedom needed to study nuclei, the author seeks to more clearly define the NRNO formalism and proposes guidelines for some calculations relevant to the debate between the NRNO formalism and other frameworks for nuclear physics research. 12 refs., 2 figs.

12757 **(DOE/ER/10353—8) Computational methods for the nuclear and neutron matter problem: Progress report [for the period 1 February 1986-31 January 1987].** Kalos, M.H.; Carlson, J.; Schmidt, K. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Nov 1986. Contract AC02-79ER10353. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003576.

Ongoing research in several areas is summarized. A brief description is made of microscopic calculations of low energy alpha-neutron scattering. This is the smallest system where the L-S splitting may be easily calculated. In order to test variational wavefunctions, the possibility of treating systems of light nuclei with the correlated basis function method has been investigated. A study of the ground state properties of ^{3}He has continued. Finally, the properties of the alpha particle and triton have been calculated with the Green's function Monte Carlo method. 1 ref., 2 figs., 3 tabs. (DWL)

12758 **(DOE/ER/40048—05-N7) Some open questions in nuclear physics.** Henley, E.M. (Washington Univ., Seattle (USA). Dept. of Physics). Oct 1986. Contract AC06-81ER40048. 13p. (CONF-8610183—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003134.

From LAMPF users group meeting; Los Alamos, NM, USA (1 Oct 1986).

A review of recent work in nuclear physics is presented. The paper gives a broad discussion of research goals in nuclear structure, quark-gluon degrees of freedom, quark-gluon plasma, symmetries, and rare decays. (DWL)

12759 **(DOE/ER/40048—31-N6) Nuclear physics issues in double beta decay.** Haxton, W.C. (Washington Univ., Seattle (USA)). 1986. Contract AC06-81ER40048. 13p. (CONF-8606205—3; CONF-860575—61). NTIS, PC A02/MF A01; GPO Dep. File Number DE87000514.

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

A number of issues in double beta decay are discussed: shell model estimates of 2nu matrix elements, a sum rule for the double Gamow-Teller operator, a comparison of shell model and quasiparticle RPA results, Pontecorvo's Te ratio argument, neutrinoless $\beta\beta$ decay mediated by heavy neutrinos, and the structure of O^+ states in Ge isotopes. 24 refs., 3 figs.

12760 **(DOE/ER/40114—T3) Precise tests for the unitarized pion photoproduction impulse amplitude in exclusive nuclear reactions.** Wittman, R. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jul 1986. Contract AC02-83ER40114. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003924.

An impulse amplitude for pion photoproduction, suitable for the nuclear problem, is constructed with improved background dynamics and unitarity. The superior features of the amplitude are demonstrated at energies between threshold (E/sub γ/ = 150 MeV) and the Δ(1232) resonance energy (E/sub γ/ = 320 MeV) by discussing their effects on partial cross sections relevant to exclusive transitions in the 1p-shell. The specific reactions of $^{13}C(\gamma,\pi^-)^{13}N$/sub g.s./ and $^{14}N(\gamma,\pi^+)^{14}C$/sub g.s./ are discussed in light of these more general partial cross sections. The nuclear structure of the A = 14 system helps to enhance the effects considered. At or near resonance, very sizable (20 to 30%) effects arise both from the unitarity and from the refined treatment of the pionic final state interaction generated in the Δ-hole approach. Other examples of charged pion photoproduction reactions for 1p-shell nuclei are discussed briefly. Future theoretical improvements and experimental possibilities are suggested. 61 refs., 58 figs.

12761 **(DOE/ER/40145—T2) Theoretical nuclear physics group: Progress in research, November 1, 1985-October 31, 1986.** (Texas Univ., Austin (USA). Dept. of Physics). Nov 1986. Contract FG05-84ER40145. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003333.

Theoretical investigations include reactions induced by light ions, reactions induced by heavy ions, and nuclear collective motions interpreted by the Boson Expansion Theory. This report consists of short synopses of specific research projects including discussions of theoretical calculations. 96 refs., 12 figs.

12762 **(DOE/ER/40199—T1) Nuclear reaction studies: Progress report.** Thaler, R.M. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics). 19 Nov 1986. Contract AC02-85ER40199. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003571.

A principal focus of recent research has been the three-body problem. A great deal of effort has been devoted to the creation of a computer program to calculate physical observables in the three body problem below 1 GeV. Successful results have been obtained for the triton. Additional work concerns scattering of K^+ mesons from nuclei, antinucleon physics, relativistic nuclear physics and inclusive reactions. (DWL)

12763 **(IAE—3878/2) On the data reliability of light nuclei description on the basis of realistic NN interactions.** Ehfros, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700380.

Examination of some attempts to solve the problem of nuclei of s- and p-shells on the basis of realistic NN-interactions is conducted. The degree of reliability of data on global nucleus characteritics obtained in this case is analyzed. The problem of accuracy of binding energy light nucleus (for example, ^{3}H, ^{4}He) fixation by D-wave weight in the deuteron in case of realistic NN-interactions is discussed. 23 refs.; 3 figs.; 5 tabs.

12764 **(INIS-BR—541) Giant resonance of electrical multipole from droplet model.** Tauhata, L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1984. 152p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87700381.

The formalism of the electrical multipole resonance developed from the Droplet nuclear model is presented. It combines the approaches of Goldhaber-Teller (GT) and Steinwedel-Jensen (SJ) and it shows the relative contribution of Coulomb, superficial and neutron excess energies. It also discusses the calculation of half-width. The model evaluates correctly the resonance energies as a function of nuclear mass and allows, through the Mixture Index, the prediction of the complementary participation of modes SJ and GT in the giant nuclear resonance. Values of the mixture index, for each multipolarity, reproduce well the form factors obtained from experiments of charged particle inelastic scattering. The formalism presented for the calculation of the half-width gives a macroscopic description of the friction mechanism. The establishment of the macroscopic structure of the Dissipation Function is used as a reference in the comparison of microscopic calculations.

12765 (INIS-SU—392, pp 125-126) **Effect of pair correlations and Coriolis mixing on the E1-transitions in odd nuclei with N=99-103.** Alikov, B.A.; Badalov, Kh.N.; Gromov, K.Ya.; Muminov, T.M.; Turaev, U.A.; Sharonov, I.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12766 (INIS-SU—392, pp 127) **Taking into account for Coriolis and quasiparticle-phonon interactions in calculations of rotational state energies and electric transition probabilities for odd deformed nuclei.** Sharonov, I.A.; Alikov, B.A.; Gromov, K.Ya.; Kvasil, Ya.; Muminov, T.M. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12767 (INIS-SU—392, pp 128) **Technique for estimation of some high-excited state lifetime in odd deformed nuclei.** Dzhelepov, B.S. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12768 (INIS-SU—392, pp 132) **Calculation of rotational spectra of odd and odd-odd nuclei according to the variable moment of inertia model with dynamic asymmetry.** Volmyanskij, Eh.I.; Grigor'ev, E.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12769 (INIS-SU—392, pp 144) **Isomeric states in sup(250)Fm and sup(254)No.** Baran, A.; Zojevski, Z.; Sobiczewski, A. 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12770 (INIS-SU—392, pp 145) **Realistic nucleon-nucleon potential accounting for quark degrees of freedom.** Krasnopol'skij, V.M.; Kukulin, V.I.; Pomerantsev, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12771 (INIS-SU—392, pp 146) **Study on the clusterization in light nuclei on the basis of electron and pion scattering.** Kukulin, V.I.; Ehramzhyan, R.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

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12772 (INIS-SU—392, pp 150) **Spectrum of collective 0sup(+) - and 1sup(-) - resonances in a sup(4)He nucleus.** Filippov, G.F.; Vasilevskij, V.S.; Kovalenko, T.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12773 (INIS-SU—392, pp 152) **Description of collective excitations of atomic nuclei in frameworks of the quasiparticle Lagrangian approach.** Platonov, A.P.; Sapershtejn, Eh.E. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

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12775 (INIS-SU—392, pp 154) **Delayed nucleon-phonon interaction and pair correlations in near magic nuclei.** Kadmenskij, S.G.; Luk'yanovich, P.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

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12776 (INIS-SU—392, pp 155) **Transition densities of isoscalar monopole giant resonances.** Kuprikov, V.I.; Soznik, A.P. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

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From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12778 (INIS-SU—392, pp 157) **Nuclear structure and A-dependence of the EMC-SLAC effect in the self-consistent approach.** Kasatkin, Yu.A.; Kirichenko, I.K.; Kuprikov, V.I.; Nagornyj, S.I. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12779 (INIS-SU—392, pp 160) **Calculation of the E1-transition probabilities in sup(78)Se, sup(78)Kr with account for microscopic structure of excited states of octupole and quadrupole type.** Dojnikov, D.N.; Erokhina, K.I.; Efimov, A.D.; Mikhajlov, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12780 (INIS-SU—392, pp 161) **On the inelastic form factor of the Osup(+) resonance in sup(4)He nucleus.** Vasilevskij, V.S.; Rybkin, I.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12781 (INIS-SU—392, pp 165) **Study on the monopole excited states of sup(12)C nucleus in the frameworks of the 3α-particle model.** Dzhibuti, R.I.; Mikhelashvili, T.Ya.; Shitikova, K.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12782 (INIS-SU—392, pp 166) **On the allowance for continuous spectrum effects by J matrix method.** Mazur, A.I.; Nechaev, Yu.I.; Smirnov, Yu.F.; Knyr, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12783 (INIS-SU—392, pp 168) **Form factors of collective state electroexcitation in light even-even nuclei.** Tartakovskij, V.K.; Isupov, V.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12784 (INIS-SU—392, pp 169) **Model of discrete correlations in a space of strong interactions.** Gorbatov, A.M. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12785 (INIS-SU—392, pp 171) **Pairing energy and M1 resonance position in self-conjugate nuclei of sd shell.** Kachan, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12786 (INIS-SU—392, pp 173) **Three-body effective interaction within fsub(7/2) nuclear shell.** Kaminski, W.A. 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12787 (INIS-SU—392, pp 175) **On the variation of the nuclear surface tension coefficient on localization of a hyperon on a surface in the (Ksup(-), πsub(-)sup(+)) reaction.** Bychkov, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12788 (INIS-SU—392, pp 177) **Criticism of the nonlinear meson theory with self-action of a scalar field.** Savushkin, L.N. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12789 (INIS-SU—392, pp 178) **Isospin mixing in mean-heavy nuclei.** Vyazankin, O.N.; Guba, V.G.; Urin, M.G. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12790 (INIS-SU—392, pp 179) **Central force effect on the spectra of the two-quasi-particle multiplets in antimony isotopes.** Artamonov, S.A.; Kovrigin, O.D. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12791 (INIS-SU—392, pp 182) **High-lying one-particle states in tin isotopes.** Vdovin, A.I.; Galinskij, E.M.; Stoyanov, Ch.; Muminov, A.I.; Safarov, R.Kh. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12792 (INIS-SU—392, pp 183) **Analytical form of one-particle wave functions of a nucleon in nucleus potential with diffusion edge.** Kon'shin, O.V.; Rudak, Eh.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12793 (INIS-SU—392, pp 184) **Approximate method for exclusion of mass center motion of a many-particle system.** Plyujko, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12794 (INIS-SU—392, pp 186) **Coulomb energies for isobar-analog states of the s-d-shell nuclei.** Solin, L.M.; Kuz'min, V.N.; Nemilov, Yu.A.; Kalinin, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12795 (INIS-SU—392, pp 187) **Empirical regularities for binding energy depending on isospin.** Solin, L.M.; Kuz'min, V.N.; Kalinin, V.A.; Nemilov, Yu.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12796 (INIS-SU—392, pp 188) **Dependence of spread widths of collective quadrupole excitations on angular momentum.** Bal'butsev, E.B.; Mikhajlov, I.N.; Piperova, J. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12797 (INIS-SU—392, pp 189) **Giant angular resonance and structure of lowest-lying nuclear states.** Mikhajlov, I.N.; Usmanov, P.N.; Yuldashbaeva, Eh.Kh. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12798 (INIS-SU—392, pp 190) **Quadrupole collective motion: old and new approaches to experiment description.** Vorov, O.K.; Zelevinskij, V.G. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12799 (INIS-SU—392, pp 193) **Modified Tamm-Dancoff method for determination of microscopic structure of α boson and interacting boson model parameters.** Mikhajlov, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12800 (INIS-SU—392, pp 197) **Spin-isospion displacement operators. Construction of multiple functions of the SU(4) group supermultiplet basis.** Vladimirov, D.M.; Gaponov, Yu.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12801 (INIS-SU—392, pp 174) **Saturation property of multi-nucleon systems and relativistic effects.** Krutov, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12802 (INIS-SU—392, pp 149) **Parameters of resonances excited in the scattering on ^{7}Li.** Fillipov, G.F.; Badalov, S.A. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12803 (INIS-SU—392, pp 162) **Nucleon momentum distribution and quasideuteron correlations in sup(3,4)He nuclei.** Cherkasov, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12804 (INIS-SU—392, pp 163) **Partial channels of photo- and electrodisintegration of a sup(14)C nucleus.** Goncharova, N.G.; Gol'tsov, A.N.; Kissener, Kh.R. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12805 (INIS-SU—392, pp 164) **Excitation and de-excitation of magnetic resonances in the sup(12)C(e,e'X) reaction.** Goncharova, N.G.; Gol'tsov, A.N.; Denisov, D.V. 1986. (In Russian). NTIS (US Sales Only), PC A99/MF A01. File Number DE87780053. (CONF-8604278—Summs.).

From 36. conference on nuclear spectroscopy and nuclear structure; Khar'kov, USSR (15 Apr 1986).

12806 **(ITEP—88-1985) Effect of nuclear spin-orbit interaction in light Σ-atoms.** Bogdanova, L.N.; Kudryavtsev, A.E.; Markushin, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki; AN SSSR, Moscow. Fizicheskij Inst.). 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700382.

It is shown that nuclear widths and shifts of light Σ-atoms levels can essentially differ for hyperfine structure states j=1 +- 1/2. This effect is due to the influence of a spin-orbit interaction on the position of near-threshold one-particle levels of a Σ-hyperon in a nucleus. 27 refs.; 3 figs.; 1 tab.

12807 **(ITF—85-75-R) Study on the mechanism of low-energy neutron interaction with heavy nuclei.** Ezhov, S.N.; Kabakova, N.E.; Plyujko, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700386.

The improved calculation method of a fluctuation component of an average cross section both with and without allowance for inelastic direct transitions is formulated. The relations between the exact and approximated approaches to the calculation of fluctuation cross sections are considered. It is shown that for the determination of the role of various mechanisms of inelastic neutron interaction within the energy range 0.5-2 MeV one can use the data either on inelastic scattering cross section or on angular distributions. 37 refs.; 7 figs.

12808 **(ITF—85-76-R) Nuclear three-body problem and energy-dependent potentials.** Abdurakhmanov, A.; Akhmadkhodzhaev, B.; Zubarev, A.L.; Irgaziev, B.F. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700387.

Energy-dependent potentials in the three-body problem are being considered. Three-particle equations for the case of pairing energy-dependent potentials are generalized and the problems related to this ambiguous generalization are investigated. In terms of the equations obtained the tritium binding energy and vertex coupling constants (Tdn) and (Tdν) are evaluated. The binding energy and, especially, coupling constants are shown to be sensitive to a shape of the energy-dependent potential. 13 refs.; 2 tabs.

12809 **(ITF—85-86-R) Nucleon mass equality effect in the elastic pd-scattering at intermediate energies.** Kuzmichev, V.E.; Peresypkin, V.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700388.

The high-energy elastic scattering in the three-particle system at an arbitrary mass relation is considered on the basis of the cluster expansion method. It is found that the accounting of the nucleon mass equality increases the differential cross section of pd-scattering in the region of the second diffraction maximum by 1.5 times and decreases the total cross section by 2%. 13 refs.; 2 figs.

12810 **(ITF—85-92-R) Elastic pα scattering at high energies.** Enkovskij, L.L.; Polozov, A.D.; Struminskij, B.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700389.

Differential and total cross sections of high-energy pα scattering are calculated within the framework of Glauber-Sitenko formalism. The dipole pomeron model is used as the amplitude of NN-scattering. The comparison of the obtained results with experimental data is made. 10 refs.; 3 figs.; 1 tab.

12811 **(ITF—85-125-R) Pauli principle effect on the behaviour of neutron-deuteron scattering near three-particle threshold.** Takibaev, N.Zh.; Kharchevnikov, P.B. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700384.

The threshold behaviour of the nd-decay reaction is found to be essentially dependent on the value of a total spin in a neutron-deuteron systems: the channel with S=3/2 turns to be suppressed by Pauli principle relative to the channel with S=1/2. There is actually no effect produced by a specific form of NN-forces. 5 refs.; 1 fig.

12812 **(ITF—85-130-R) Relativistic deuteron fragmentation into proton and the deuteron structure at small distances.** Anchishkin, D.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700385.

The deviation of experimental data on the cross sections of deuteron fragmentation into protons on ^{12}C at different energies with the calculated ones on the known two-nucleon wave functions is analysed. The similarity of the deviations is interpreted as the manifestation of the deuteron nonnucleon degrees of freedom at small distances. It is shown that the hybrid model describes the experimental data on the cross section of the deuteron fragmentation on ^{12}C. The relativistic effects are taken into account in the framework of the light-cone dynamics. 13 refs.; 4 figs.

12813 **(ITP—85-18-E) Generalized hyperspheric function method and the pion scattering by nucleus of ^{18}O.** Gmitro, M.; Steshenko, A.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700390.

In the framework of the known multiple scattering theory the differential cross section of the $^{18}Q(PI, PI)$ reaction for the energies 29, 164, 180 and 230 MeV is calculated. The wave functions of the ground state and excited states of the nucleus ^{18}O are found in the minimum approach of generalized hyperspheric function method. The pion-nucleus t sub(PIA) matrix is constructed by solving the Lippman-Schwinger equation on-energy-shell and taken into account the phases of PIN - scattering. Theoretical values of oifferential cross section of the (PI^{+-} - ^{18}O)-reaction under consideration adequately describe experimental data. 24 refs.; 5 figs.; 2 tabs.

12814 **(ITP—85-19-E) Phenomenological Hamiltonian of Sp(2,R) model for heavy deformed nuclei.** Avramenko, V.I.; Asherova, R.M.; Filippov, G.F.; Smirnov, Yu.F.; Zajtsev, S.A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700383.

In the frame of the symplectic collective model, operating with the microscopical basic functions of irraducible representation of SU(3) groups the energy spectrum of collective excitation in ^{164}Kr nucleus is calculated. Also the absolute and relative values of probabilities E2-transitions between collective states are obtained. The indexes of SU(3) symmetry are chosen in correspondence with rules of Nillsson orbital occupation. 20 refs.; 3 tabs.

12815 **(ITP—85-25-E) On the nature of resonances in photonuclear reactions.** Filippov, G.F.; Vasilevsky, V.S.; Kruchinin, S.P.; Chopovsky, L.L. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700391.

An investigation of continuous spectrum states of the ^{6}He, ^{6}Li, ^{7}Li and ^{7}Be light atomic nuclei is carried out within the microscopic approach taking into account the dynamics of cluster and quadrupole collective degrees of freedom. The interaction of these nuclei with electromagnetic radiation is shown to lead to the excitation of collective resonances with energy exceeding 20 MeV and width GITA<1 MeV, and also giant quadrupole resonances with parameters: E=12-15 MeV and GITA approximately 5 MeV. 48 refs.; 6 figs.

12816 (ITP—85-38-E) Faddeev approach in three-quark systems. Kuperin, Yu.A.; Kvintsinskij, A.A.; Merkur'ev, S.P.; Novozhilov, V.Yu. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700371.

Calculations of baryon static properties represent a noval field where the Faddeev differential equations are applied. The mass spectra and were functions of baryons from multiplets of spin-partity Jsup(P)=1/2$^+$, 3/2$^+$ are investigated in non-relativistic quark model. The structure parameters characterizing the "quality" of the baryon wave functions, i.e. charge radii, electromagnetic form factors quark distribution functions, are calculated. It is shown that the majority of the popular qq-potentials do not give "high quality" wave functions in spite of the good fit for the hadron masses. 29 refs.; 4 figs.; 3 tabs.

12817 (ITP—85-59-E) Studies of the three-nucleon system properties using the interpolating amplitude scattering function. Petrov, N.M.; Pushkash, A.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700392.

The three-nucleon motion problem is formulated and investigated using the interpolating function method. The pole functions corresponding to the bound state of the three-nucleon system and the low energy functions interpolating the nd-scattering length are calculated for a separable potential. 10 refs.; 5 figs.; 1 tab.

12818 (JINR—E-7-85-575) Two-stage model for fast particle emission in heavy-ion collisions. Biedermann, M.; Maedler, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Technische Univ., Dresden (German Democratic Republic). Sektion Physik). 1985. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700393.

Submitted to the journal Z. Phys., A.

Using Bertsch's trajectory model two physically distinct approaches is applied to describe fast particle emission in heavy-ion collisions. In the early stage particle emission in the spirit of the Fermi-jet mechanism is calculated. In the later stage, after neck formation, particles are assumed to be emitted from a rapidly expanding hot zone of appreciably large initial dimension, which is strongly anisotropic in momentum space. Absolute double-differential cross sections for preequilibrium neutron emission and obtain a remarkable agreement with experimental data without introducing free parameters are calculated. 53 refs.; 13 figs.

12819 (JINR—R-1-85-315) Structure functions and quark distributions in nuclens and nuclei. Savin, I.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 48p. (In Russian). (CONF-840757—40). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700396.

From 22. international conference on high energy physics; Leipzig, German D.R. (19 Jul 1984).

The data obtaned in the course of studying quark distribution in nucleons and nuclei are discussed. The results of measuring the R(x, Q^2) parameter which is determined through the relation of structure functions are considered. The experiments on studying nuclear effects in nucleon structure functions are analyzed. It is pointed out that the EMC effect, lepton-nucleus and hadron-nucleus interactions indicate the existence in nuclei of multiquark states. The data on structure functions determined from deep inelastic muon and neutrino scattering on nuclei are given. 59 refs.; 36 figs.; 4 tabs.

12820 (JINR—R-1-85-668) Analysis of experimental data on light nucleus production in relativistic αA-interactions within the generalized coalescence model. Gorshkova, N.L.; Denisenko, K.G.; Lozhkin, O.V.; Murin, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Radievyj Inst., Leningrad (USSR)). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700395.

Inclusive cross section of production isotopes from ^{1}H to ^{6}Li with kinetic energy 10-50 MeV/N in collisions of 3.33 GeV/N α particles with Ag and Au nuclei are analyzed. Variation of coalescence model is suggested to describe spectra in that energy range. In the model together with the usual parameter P_0 - the radius of coalescence sphere in momentum representation a new parameter Esub(c) is used. It characterizes Coulomb potential of the fragment source. To obtain spectra of nucleons from which fragments have been formed the experimnental ratio formed with the help of the found nucleon distributions give ^{6}He, sup(6, 7, 8)Li spectra. Comparison of the results with experimental data shows a good agreement. The parameters P_0 and Esub(c) have been found and the simplest interpretation is considered. For α-particle source the value of charge number Zsub(r)=30 and 1.4 normal nuclear density value have been obtained. 10 refs.; 5 figs.; 2 tabs.

12821 (KFTI—84-27) Effect of antisymmetry of final states on cross sections of the ^{4}He(γ,p)^{3}H and ^{4}He(γ,n)^{3}He reactions with polarized photons. Mel'nik, Yu.P.; Shebeko, A.V. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700394.

In the plane-wave pulse approximation cross sections and asymmetry in distributions of ^{7}He(γ, p)^{3}H and ^{4}He(γ, n)^{3}He reaction products with polarized photons of intermediate energies (Ksub(γ)=40-140 MeV) are calculated. In calculations along with the mechanism of direct knocking-out of nucleons the contribution of the so called recoil diagram caused by antisymmetry effects of final state wave functions is considered. It has been assumed that the ^{4}He, ^{6}He and ^{3}H wave functions are spatially-symmetric corresponding to S-wave states of nucleons of oscillator model while the electromagnetic transition operator comprises only convection current and magnetic interaction. It is shown that recoil mechanism results in appearance of asymmetry in neutron distributions compared by value with proton asymmetry. 25 refs.; 4 figs.

12822 Quark cluster model for nuclear matter through variational approach. Tosa, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2302-2311(Dec 1986).

As a model for nuclear matter based on quark clustering, we consider a system of fermions carrying color, interacting through a δ-function potential in one dimensional space. The dynamical properties of the system are studied by the variational method as a function of density. We develop a trial wave function for triplet (three-quark) clusters in analogy to the BCS wave function for pairs in the theory of superconductivity. We show that the system consists of a Fermi gas of color-neutral triplet clusters (nucleons) at low density and a Fermi gas of quarks in the limit of high density. The low density result agrees with the exact result derived by the method of the Bethe ansatz through second order in density.

12823 Gauge-invariant nuclear Compton amplitude manifesting low-energy theorems. Friar, J.L.; Fallieros, S. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2029-2042(Dec 1986).

The electromagnetic field representation of the nuclear electromagnetic interaction is developed, by extending previous work on the nuclear current (one-photon amplitude) to the nuclear Compton amplitude. The resulting form of the Compton amplitude is gauge invariant and, in transverse gauge, manifests the low-energy theorems for the $0^+ \rightarrow 0^+$ case, which is discussed in detail. Deuteron forward photodisintegration is also studied numerically, and it is shown that the generalized Siegert form of the retarded electric dipole interaction efficiently incorporates pion-exchange currents implicitly, while large explicit forms of these currents are needed in the standard representation of the interaction. Gauge invariance and Reiss's strong-field momentum-translation approximation are also discussed.

12824 Measurements and calculations of neutron scattering in the actinide region. Hansen, L.F.; Pohl, B.A.; Wong, C.; Haight, R.C.; Lagrange, C. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2075-2083(Dec 1986). Contract W-7405-ENG-48.

Neutron scattering differential cross sections were measured for /sup 232/Th, /sup 238/U, and /sup 239/Pu at 14.1 MeV. Optical model calculations were performed using the coupled-channel formalism for deformed nuclei as given by Tamura. Several microscopic and phenomenological optical model potentials were tested for these heavy nuclei: (i) a folding optical model potential using the microscopic nucleon-nucleon effective interaction of Jeukenne, Lejeune, and Mahaux with deformed nuclear density distributions (these calculations are addressed in the text as semimicroscopic optical model potentials), (ii) global phenomenological optical model potentials optimized for the actinide region, and (iii) neutron potentials derived from 35 MeV proton optical potentials using the Lane formalism. The total cross sections calculated from these optical model potentials at 14.1 MeV are also compared with measurements in the literature. The semimicroscopic calculations reproduce reasonably well the measured angular distributions with only two free parameters used to optimize fits to the data. The calculations carried out with optical potentials inferred from proton data give good agreement with the neutron data, an agreement which is similar to that between calculational results using neutron global potentials optimized for this mass region and the measured data.

12825 Reply to Comment on Comparison of approximate chiral-dynamical $\pi N \rightarrow \pi\pi N$ models used in A(π,2π) calculations. Liu, L.C. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2351-2352(Dec 1986).

It is shown that in forward-angle pion-nucleus double charge exchange reactions leading to double analog states the contribution from the contact diagram of the virtual pion production does not vanish identically. Numerical effects of this diagram in various other double charge exchange reactions should, therefore, be examined case by case.

12826 Observations on rotating finite-range fission barriers derived from barriers for nonrotating nuclei. Blann, M. (Division, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 6, 2215-2216(Dec 1986). Contract W-7405-ENG-48.

Fission barriers calculated from the rotating liquid drop model with finite-range corrections based on scaling of the nonrotating finite-range model of Krappe et al. are compared with results explicitly calculated for rotating systems with the finite-range effect included. The scaling method is shown to give excellent agreement with the calculated barriers, confirming earlier conclusions on effective fission barrier heights based on the scaling procedure.

12827 Neutron multiplicity equation and its application for (n,2n) multiplication measurements by statistical correlation techniques. Kumar, A.; Srinivasan, M. (Institut de Genie Atomique, Ecole Polytechnique Federale de Lausanne, PHB-Ecublens, CH-1015 Lausanne). *Nuclear Science and Engineering;* **93**: No. 3, 240-247(Jul 1986).

A new equation, called the neutron multiplicity equation (NME), has been derived starting from basic physics principles. Neutron multiplicity v is defined as the integral number of neutrons leaking from a neutron multiplying system for a source neutron introduced into it. Probability distribution of neutron multiplicities (PDNMs) gives the probability of leakage of neutrons as a function of their multiplicity v. The PDNM is directly measurable through statistical correlation techniques. In a specific application, the NME has been solved for PDNM as a function of v for /sup 9/Be spheres of varying radii and driven by a centrally located 14-MeV deuterium-tritium neutron source. The potential of NME for sensitivity analysis is demonstrated through a particular modification of secondary neutron transfer cross sections of /sup 9/Be. It turns out that PDNM is very sensitive, even as the "average" neutron leakage is practically insensitive to it.

12828 Nuclear information needs for the astrophysical s-process. Mathews, G.J.; Howard, W.M.; Takahashi, K.; Ward, R.A. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA 94550). pp 927-931 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The astrophysical s-process is a sequence of neutron-capture and beta-decay reactions on a slow time scale compared to beta-decay lifetimes near the line of stability. The authors systematically study this detailed sequence of neutron capture, continuum and bound-state beta decay, positron decay, and electron-capture reactions that comprise the s-process for a broad range of astrophysical environments. The results are then compared with the solar-system abundances of heavy elements to determine the range of physical conditions responsible for their nucleosynthesis. The nuclear data needs are extensive, but have begun to be precise enough to allow for a consistent interpretation of the astrophysical site for the s-process.

12829 Calculated neutron-induced cross sections for /sup 63,65/Cu, /sup 58,60/Ni, and /sup 52/Cr from 1 to 20 MeV and comparisons with experiments. Hetrick, D.M.; Fu, C.Y.; Larson, D.C. (Oak Ridge National Lab.). pp 1197-1200 of Nuclear data for basic and applied science. Volume 2. Young, P.G.; Brown, R.E.; Auchampaugh, G.E.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Nuclear model codes were used to compute cross sections for neutron-induced reactions on /sup 63,65/Cu, /sup 58,60/Ni, and /sup 52/Cr for incident energies from 1 to 20 MeV. The input parameters for the model codes were determined through analysis of experimental data in this energy region. The models used, the input data, the resulting calculations, and comparisons with measured data are discussed.

12830 Uncertainty propagation from raw data to final results. Larson, N.M. (Oak Ridge National Lab.). pp 1593-1596 of Nuclear data for basic and applied science. Volume 2. Young, P.G.; Brown, R.E.; Auchampaugh, G.E.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Reduction of data from raw numbers (counts per channel) to physically meaningful quantities (such as cross sections) is in itself a complicated procedure. Propagation of experimental uncertainties through that reduction process has sometimes been perceived as even more difficult, if not impossible. At the Oak Ridge Electron Linear Accelerator, a computer code ALEX has been developed to assist in the propagation process. The purpose of ALEX is to carefully and correctly propagate all experimental uncertainties through the entire reduction procedure, yielding the complete covariance matrix for the reduced data, while requiring little additional input from the experimentalist beyond that which is needed for the data reduction itself. The theoretical model used in ALEX is described, with emphasis on transmission measurements. Application to natural iron and natural nickel measurements is shown.

12831 Nuclear transport-phenomena in low-energy heavy-ion collisions. Huizenga, J.R.; Schroeder, W.U. (Univ. of Rochester, NY). pp 255-279 of Semiclassical descriptions of atomic and nuclear collisions. Bang, J.; de Boer, J. (eds.). Amsterdam, Netherlands; Elsevier Science Publishers B.V. (1985).

From Proceedings of the Niels Bohr centennial conference; Copenhagen, Denmark (25-28 Mar 1985).

The characteristic properties of a new nuclear reaction mechanism induced in low-energy heavy-ion collisions are discussed. Collision dynamics and final fragment production are indic-

ative of transport processes occurring in nuclear matter far from equilibrium. These relaxation mechanisms are mediated dominantly by the exchange of independent nucleons between the reaction partners. 15 references, 32 figures.

12832 **Static deformations and rotational excitations of baryons in the Skyrme model.** Hajduk, C.; Schwesinger, B. (State Univ. of New York, Stony Brook). *Physics Letters [Section] B;* **145B**: No. 3-4, 171-175(20 Sep 1984). Contract AC02-76ER13001.

The stability of baryons against static quadrupole deformations is studied. In the Skyrme model the nucleon and the Δ-isobar turn out to be spherical. States having a spin different from their isospin ($K > 0$) are strongly deformed and lie ~500 MeV above the ground states. 12 references, 2 figures, 1 table.

12833 **Watson's theorem and resonant pion photoproduction amplitude in the delta channel.** Wittman, R.; Davidson, R.; Mukhopadhyay, N.C. (Rensselaer Polytechnic Institute, Troy, NY). *Physics Letters [Section] B;* **142B**: No. 5,6, 336-339(2 Aug 1984). Contract AC02-83ER40114.

The CGLN and BL theories of the pion photoproduction on nucleons, used in nuclear calculations, are examined regarding their predictions of the resonant $M_1 +$ and $E_1 +$ multipoles. The nonunitary BL approach violates Watson's theorem, and predicts these multipoles poorly. In the static limit, the CGLN multipoles satisfy Watson's theorem and are in fine agreement with data. The unitarized BL multipoles agree with those from the Olsson theory and data. 15 references, 3 figures.

12834 **Breakup-fusion description of nonequilibrium protons from (α,p) reactions.** Udagawa, T.; Li, X.H.; Tamura, T. (Univ. of Texas, Austin). *Physics Letters [Section] B;* **135B**: No. 5-6, 333-336(16 Feb 1984).

The nonequilibrium part of the proton spectra from a few (α,p) reactions is calculated, assuming the breakup-fusion (BF) mechanism. It is shown that the calculation reproduces very well the higher-energy parts of the observed spectra, but underestimates the lower-energy parts. The reason why this happens and a plausible mechanism that may fill up this gap are discussed. 12 references, 2 figures.

12835 **Theoretical aspects of double beta decay.** Haxton, W.C. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 252-267 of Fifth workshop on grand unification. Kang, K.; Fried, H.; Frampton, P. Singapore, Singapore; World Scientific Pub. Co. Pte. Ltd. (1984). (CONF-8404155—).

From 5. workshop on grand unification; Providence, RI, USA (12 Apr 1984).

Considerable effort has been expended recently in theoretical studies of double beta decay. Much of this work has focused on the constraints this process places on gauge theories of the weak interaction, in general, and on the neutrino mass matrix, in particular. In addition, interesting nuclear structure questions have arisen in studies of double beta decay matrix elements. After briefly reviewing the theory of double beta decay, some of the progress that has been made in these areas is summarized.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 11222, 12664, 12728, 12749

12836 **(DOE/ER/60474—1) Biophysical studies related to energy generation: Eighteen year progress report.** Green, A.E.S. (Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences). 24 Dec 1986. Contract FG05-86ER60474. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003908.

Research accomplishments are briefly summarized. These include the successful transfer of the detailed atomic cross section approach from aeronomy to radiological physics, the application of analytic shell and optical model electron-atom potentials to estimations of electronic excitation and ionization cross sections for radiological applications, the use of two dimensional yield spectra to applied energy degradation studies, research into energy-atmospheric environments, and work on connecting gaseous and liquid phase electron energy loss measures. A list of publications is included.

12837 **(IAE—3870/4) Restoration of an approximate neutron pulse shape according to known temporal moments.** Stolypin, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700378.

The formula for the approximate neutron pulse description through the whole neutron energy range is suggested. It goes over into the known formulae for neutron pulse description with the energy exceeding greatly the energy of thermal motion of moderator nuclei, and into the formula describing time variations of neutron distributions which are in equilibrium with moderator nuclei. The error in peak value determination of neutron density is shown not to exceed 10%. 10 refs.; 4 figs.; 3 tabs.

12838 **(IAE—3942/4) Comparison of solutions of a nonstationary diffusion equation and the telegraph equation for the description of time variation of the thermal neutron density.** Stolypin, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700379.

Solutions of the telegraph and neutron nonstationary diffusion equations are analyzed. Applicability limits for diffusion approximation are established to describe thermal neutron transport. Solutions of the telegraph and neutron nonstationary diffusion equations, used for the description of thermal neutron transport, are shown to be similar, if a thermal neutron source is the density of fast neutron slowing-down into thermal one. 6 refs.

12839 **(INIS-BR—543) Direct observation of gliding dislocations interactions with defects in irradiated niobium single crystals by means of the high voltage electronic microscopy (HVEM).** Otero, M.P. (Sao Paulo Univ. (Brazil)). 1985. 156p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number DE87700350.

The interactions of gliding dislocations with defects in irradiated niobium that result in the formation of dislocations channels. The effects in the mechanical behaviour of [941]- and [441]- oriented Nb single crystals due to oxygen addition, neutron and electron irradiation was observed either by macroscopic deformation in a Instron machine or 'in-situ' deformation in the HVEM-High Voltage Electron Microscope. Some specimens were irradiated at IPNS-Intense Pulsed Neutron Source, at 325 K, with 5×10^{17} n/cm², others were irradiated with electrons in the HVEM. The interactions between gliding dislocations with clusters point defects and dislocations were observed. The primary mechanism for removal of the clusters by the gliding dislocations was the 'sweeping' of the clusters along with the gliding dislocations. As to the point defects, they were 'swept' by the gliding dislocations and left as aligned loops close to the intersections of the gliding dislocations with the upper and lower specimen surfaces. For the illustration of this phenomena, a schematic drawing was made. The mechanism of 'bowing-out' interaction of dislocations with defect clusters was also observed. The reported anomalous slip observed to operate in the [941]- oriented Nb was also directly observed and a qualitive explanation along with a schematic drawing was proposed. This would explain the softenig observed after the yield stress in the [941]- oriented Nb deformed in the Instron machine.

12840 (INIS-SU—369, pp 295-297) **Distribution of hadron intranuclear cascade for large distance from a source.** Bibin, V.L.; Kazarnovskij, M.V.; Serezhnikov, S.V. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1985. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number DE87780052. (CONF-8410203—Vol.2).

From 9. All-Union conference on charged particle accelerators; Dubna, USSR (16 Oct 1984).

Analytical solution of the problem of three-component hadron cascade development for large distances from a source is obtained in the framework of a series of simplifying assumptions. It

makes possible to understand physical mechanisms of the process studied and to obtain approximate asymptotic expressions for hadron distribution functions.

12841 (LAFI—079) Role of 3d-ions for radiation defect production in MgO and $MgAl_2O_4$. Mironova, N.A.; Grinvald, G.A.; Skvortsova, V.N. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700352.

Optical properties of MgO and $MgAl_2O_4$ crystals containing chromium and manganese impurity ions were studied by exposure to but all types of radiation. Complicated defects of the "impurity-intrinsic matrix defect" type were preferably considered. It has been shown that different symmetry center forming chromium ions in MgO:Crsup(3+) change their valency with various efficiency being exposed to external action. Besides, the compensating vacancy does not participate in the hole center formation. For $MgOxAl_2O_3$ single crystals the presence of octahedrally coordinated manganese ions suppresses the hole center creation by gamma-irradiation. Studying luminescence spectra of Crsup(3+) ions in $MgAl_2O_4$ it has been states that neutron irradiation increases the degree of inversion for the magnesium-aluminium spinel. 38 refs.; 13 figs.

12842 Incorporation of Monte Carlo electron interface studies into photon general cavity theory. Horowitz, Y.S.; Moscovitch, M.; Mack, J.M.; Kearsley, H.H.E. (Ben Gurion Univ. of the Negev, Physics Dept., Beersheva 84105). *Nuclear Science and Engineering;* **94**: No. 3, 233-240(Nov 1986).

Electron Monte Carlo calculations using CYLTRAN and a new PHSECE (Photon-Produced Secondary Electrons) technique were carried out to estimate electron fluences and energy deposition profiles near LiF/Al and LiF/Pb material interfaces undergoing /sup 60/Co gamma irradiation. Several interesting and new features emerge: (a) although the buildup of the secondary electron fluences at the interfaces of the irradiated media is approximately exponential, the value of the electron mass fluence buildup coefficient, γ, is not equal to the electron mass fluence attenuation coefficient, β; (b) the β value of the attenuation of the gamma generated electron fluences at the cavity/medium interfaces is strongly dependent on the Z of the adjacent material; and (c) for LiF/Pb there is a significant "intrusion" energy deposition mode arising from sidescattering in the wall material (lead).

12843 Approximate solution to the Kolmogorov equation for a fission chain-reacting system. Ruby, L.; McSwine, T.L. (Univ. of California, Berkeley, Dept. of Nuclear Engineering, Berkeley, CA). *Nuclear Science and Engineering;* **94**: No. 3, 271-273(Nov 1986).

An approximate solution has been obtained for the Kolmogorov equation describing a fission chain-reacting system. The method considers the population of neutrons, delayed-neutron precursors, and detector counts. The effect of the detector is separated from the statistics of the chain reaction by a weak coupling assumption that predicts that the detector responds to the average rather than to the instantaneous neutron population. An approximate solution to the remaining equation, involving the populations of neutrons and precursors, predicts a negative-binomial behaviour for the neutron probability distribution.

12844 Choice of biasing function for source biasing. Gelbard, E.M. (Argonne National Lab., Applied Physics Div., Argonne, IL). *Nuclear Science and Engineering;* **94**: No. 3, 274-276(Nov 1986).

Two different descriptions have been used for Monte Carlo source biasing. One relies on a direct optimization of biasing parameters, the other on an intuitive application of the adjoint flux. But use of the adjoint flux is based on the assumption that importance sampling will be used throughout the calculation, and that source sampling will not be stratified. It is shown that if these conditions are not satisfied, use of the importance functions has no theoretical justification and, in principle, biasing parameters must be optimized directly. Source biasing is probably the simplest, and one of the oldest, of all variance-reduction techniques, and one might suppose that it is, by now, perfectly well understood.

12845 A flux-limited diffusion model for charged-particle transport. Dorr, M.R. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA). *Nuclear Science and Engineering;* **94**: No. 2, 157-166(Oct 1986).

A new algorithm for modeling charged-particle transport in a fully ionized plasma is presented. A standard multigroup discretization of the Fokker-Planck-Boltzmann equation is transport corrected to implicitly include the anisotropic effects of both coulomb scattering and nuclear reactions. This allows the subsequent application of the Levermore flux-limited diffusion theory, which was originally developed for isotropic radiative transfer calculations. A finite differencing of the resulting spatial transport operator is constructed so as to yield centered and upwinded operators in the diffusion and free-streaming limits, respectively. The time integration is performed by the general purpose ordinary differential equation solver TORANAGA. This approach results in a highly vectorizable algorithm that has been implemented on the CRAY-1. Some numerical results are presented that compare this algorithm to the corresponding, but far more expensive, Monte Carlo calculations.

12846 An interpolation method for functions of two variables with applications to radiation measurements. Hsu, H.H. (Los Alamos National Lab., Physics Div., Mail Stop D410, Los Alamos, NM). *Nuclear Science and Engineering;* **94**: No. 2, 199-205(Oct 1986).

An interpolation method is developed for functions of two variables. This approach uses semiempirical formulas with several parameters, avoiding the large data base and repetitious calculations characteristic of the usual interpolation methods. Two examples illustrate the method. In principle, the method can be extended to cases with more than two variables.

12847 Carbon Kerma factor for 18- and 20-MeV neutrons. DeLuca, P.M. Jr.; Barschell, H.H.; Burhoe, M.; Haight, R.C. (Univ. of Wisconsin, 1300 University Avenue, Madison, WI). *Nuclear Science and Engineering;* **94**: No. 2, 192-198(Oct 1986).

Earlier measurements of the kerma factor of carbon have been extended to neutron energies of 18 and 20 MeV. The measured values are lower than published values based on estimated microscopic cross sections.

12848 A finite element projection method for the solution of particle transport problems. Wills, E.; Roderick, N.; McDaniel, P. (McClellan Central Lab., McClellan Air Force Base, Sacramento, CA 95652). *Nuclear Science and Engineering;* **93**: No. 3, 291-307(Jul 1986).

A method for solving particle transport problems has been developed. In this method the particle flux is expressed as a linear and separable sum of odd and even components in the direction variables. Then a Bubnov-Galerkin projection technique and an equivalent variational Raleigh-Ritz solution are applied to the second-order transport equation. A dual finite element basis of polynomial splines in space and spherical harmonics in angle is used. The general theoretical and numerical problem formalism is carried out for a seven-dimensional problem with anisotropic scattering, time dependence, three spatial and two angular variables, and with a multigroup treatment of the energy dependence. The boundary conditions for most physical problems of interest are dealt with explicitly and rigorously by a classical minimization (variational) principle. Finally, the computational validation of the method is obtained by a computer solution to the monoenergetic steady-state air-over-ground problem in a cylindrical (r,z) geometry and with an exponentially varying atmosphere.

12849 Some remarks on convergence and stability in ray-tracing calculations. Nelson, P.; Zelany, R. (Institute for Numerical Transport Theory, Dept. of Mathematics, Texas Tech Univ., Lubbock, TX 79409). *Nuclear Science and Engineering;* **93**: No. 3, 283-290(Jul 1986).

A class of finite difference methods, the linear one-cell functional methods, is introduced, and observed to encompass the vast majority of spatial approximations used in one-dimensional transport theory. It is noted that, under minimal additional assumptions, these methods satisfy the classical result, valid for one-step finite

difference approximations to initial value problems, that consistency implies both convergence and stability. This explains the observed absence of nonconvergence and instability from ray-tracing calculations, and also indicates the limitations of this result.

12850 **Generalization of neutron transport predictive models utilizing sensitivity theory and its implementation into a computer code.** Bhuiyan, S.I.; Roussin, R.W.; Lucius, J.L.; Marable, J.H.; Bartine, D.E. (Bangladesh Atomic Energy Commission, Institute of Nuclear Science and Technology, P.O. Box 3787, Dhaka). *Nuclear Science and Engineering;* **93**: No. 3, 313-317(Jul 1986).

Three models, a linear, exponential or BEST, and a power model, developed using sensitivity theory to predict deep-penetration neutron transport in practical shielding problems, have been generalized into a common expression. One can obtain any of the above three models from this generalized expression simply by choosing the proper index parameters. Subsequently, a scheme for implementation of this into a computer code was adopted in "SENATOR." SENATOR replaces the SENTINEL module of the Oak Ridge National Laboratory (ORNL) FORSS system. The supporting data bases (i.e., the sensitivity profile) and the Fortran code, along with some utility programs, are assembled in a package identified as CONSENT and can be obtained through the Radiation Shielding Information Center at ORNL.

12851 **A combination of F/sub n/ and TP/sub n/ methods.** Ganguly, K. (Texas Tech Univ., Dept. of Mathematics, Lubbock, TX 79409). *Nuclear Science and Engineering;* **93**: No. 3, 308-312(Jul 1986).

The ideas of the F/sub N/ and transport P/sub N/ approximation (TP/sub N/) methods in transport theory are suitably combined to formulate an accurate approximation scheme for the monoenergetic transport equation. The method involves the use of the singular integral equation for the surface flux as used in the F/sub N/ method and angular flux representation of the TP/sub N/ approximation. This leads to a consistent approximate scheme for the computation of angular flux.

12852 **A calorimetric measurement of the heat deposition in the vicinity of a spallation neutron target.** Fischer, W.E.; Moritz, L.; Spitzer, H.; Thorson, I.M. (Schweizerisches Institut fur Nuklearforschung, 5234 Villigen). *Nuclear Science and Engineering;* **93**: No. 3, 273-282(Jul 1986).

An experiment to measure the heat deposition in various materials in the vicinity of a spallation neuron target is described. This experiment has been performed at the Thermal Neutron Facility, TRIUMF. In the analysis of the data, the contributions to the heat deposition from (n,γ) capture processes, fast neutron, and prompt gamma-ray scattering are separated.

12853 **Resonance self-shielding in fast neutron spectra.** Mo, S.C. Lafayette, IN; Purdue Univ. (1986). 246p. University Microfilms Order No. 86-22,196.

Thesis (Ph. D.).

The study of resonance self-shielding in heterogeneous media has direct applications on the design and analyses of fast neutronic problems. Integral reaction rate measurements using resonance detector foils require a self shielding correction to account for the spatial shielding effect of the foil. Typical experimental correction technique based on extrapolating measurements for several foils of different thicknesses can lead to uncertainties in the experimental data. A new analysis method was developed to evaluate the foil correction factors of resonance detectors in fast neutron spectra. The new analysis method is based on an iterative treatment of the integral transport equation that describes the single and multiple scattering processes inside the detector foil. The foil correction factor at each experimental position is related to the impinging neutron spectrum by combining the resonance self-shielding factors of individual Doppler broadened resonances with the multigroup reaction rates obtained from the results of a two-dimensional diffusion theory calculation. Another important subject concerning heterogeneous resonance self-shielding occurs near a zone interface that separates regions of a different material compositions. Such transition was observed experimentally in the capture data of ^{238}U near the FBBF transformer-blanket interface.

12854 **Capture in the 1.15-keV iron resonance.** Weston, L.W.; Todd, J.H. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 585-588 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The 1.15-keV resonance in iron is important to fast reactors in that a major part of the iron capture integral is due to this one resonance. This resonance is also a good test case for capture gamma-ray detectors, which are meant to have an efficiency independent of gamma-ray energy spectra, because this resonance has an unusually hard spectrum and other iron resonances do not. There have been severe discrepancies among different groups who have measured the capture area and transmission of this resonance. A new measurement, employing C/sub 6/F/sub 6/ liquid scintillators and pulse-height weighting to effect total energy detection, has been made of the ratio of the capture area of the 22.8-keV resonance relative to that of the 1.15-keV resonance. The 22.8-keV resonance has a relatively soft gamma-ray spectrum and there is agreement on the capture area. The results (2.91 +. 0.17) agree well with transmission measurements and confirm the applicability of total energy detectors for use on capture resonances with very hard capture gamma-ray spectra.

12855 **VITAMIN-E 174n, 38G general purpose cross-section library.** Roussin, R.W.; White, J.E.; Bartley, J.L. (Radiation Shielding Information Center, Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN 37831). pp 799-802 of Nuclear data for basic and applied science. Volume 1. Young, P.G.; Brown, R.E.; Auchampaugh, G.F.; Lisowski, P.W.; Stewart, L. New York, NY; Gordon and Breach (1985). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

VITAMIN-E, offering a different approach to obtaining multigroup cross sections for a wide range of radiation transport analyses, is now available from RSIC.

6550 Medical Physics

REFER ALSO TO CITATION(S) 12695, 12727

12856 (INIS-mf—10100, pp 41) **Experiences of glow curve analysis of LiF detectors.** Uray, I.; Rose, E.; Hintzen, M.; Probst, H.J. (Magyar Tudomanyos Akademia, Debrecen; Kernforschungsanlage Juelich G.m.b.H., Germany). Oct 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE86780531. (CONF-851056—Absts.).

From Computer aided methods in radiation protection; Budapest, Hungary (22 Oct 1985).

12857 **(LA-UR—86-3777) X-ray safety at the Los Alamos National Laboratory.** Gutierrez, J.A. (Los Alamos National Lab., NM (USA)). Nov 1986. Contract W-7405-ENG-36. 5p. (CONF-870219—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002920.

From Midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

An organized and structured safety program for x-ray generating devices was initiated in October, 1979. An X-ray Device Control Office was established to manage the program that currently oversees the activities of 201 x-ray generating devices and to provide SOP reviews, perform shielding calculations, and provide training for both the operators and health physics x-ray device surveyors. The new program also establishes controls for procurement of new equipment, requires the writing of Standard Operating Procedures, requires training for operators and provides routine and non-routine safety inspections of x-ray generating devices. Prior to this program going into effect, the Laboratory had recorded nine documented x-ray related exposure accidents. Since then, there

have been none. Program elements and experiences of interest to other x-ray device users are discussed. 3 refs.

12858 **(PNL-SA—13687) Status of beta measurement evaluation and upgrade program.** Swinth, K.L. (Pacific Northwest Lab., Richland, WA (USA)). 1986. Contract AC06-76RL01830. 6p. (CONF-860149—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002062.

From DOE beta measurement workshop; Albuquerque, NM, USA (23 Jan 1986).

In 1983, the US Department of Energy (DOE) initiated a program to evaluate and upgrade beta dosimetry capabilities at DOE and DOE-contractor facilities. The program has several elements which structure the development of improvements in beta measurement practices. In addition to Pacific Northwest Laboratory (PNL), universities, private corporations, and other DOE facilities are involved in the research efforts.

12859 **(UCRL—95043) Production and shielding of x rays from electron beam vapor sources.** Singh, M.S. (Lawrence Livermore National Lab., CA (USA)). 14 Nov 1986. Contract W-7405-ENG-48. 12p. (CONF-870219—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002756.

From Midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines; Reno, NV, USA (8 Feb 1987).

Electron-beam vapor sources are now widely used in material processing sciences and coating technologies, such as the semiconductor industry for producing aluminum films on Si wafers; the metallurgical industry for melting, evaporating, and refining metals; and at Lawrence Livermore National Laboratory (LLNL) for vaporizing metals for laser isotope separation applications. Power for these sources ranges from the kW regime in the semiconductor industry to the multi-MW regime in laser separation technology. Operations of these sources can generate copious amounts of x rays by the direct and indirect interactions of the energetic electrons with the target materials. In this paper, we present the results of our calculations regarding the x-ray emission intensity, angular intensity and energy spectrum distribution, and shielding characteristics for vapor sources with acceleration voltages from 10 kV to 60 kV. 4 refs., 12 figs., 2 tabs.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 11857

12860 **(CONF-870220—1) Resonance ionization mass spectrometry using ion-beam sampling.** Goeringer, D.E.; Christie, W.H. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87001834.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

Resonance ionization mass spectrometry has been used to study the effects of surface chemistry on neutral yields from ion-beam sputtered samples. 2 refs., 2 tabs.

12861 **(DOE/ER/45199—T1) Inelastic scattering in condensed matter with high intensity Moessbauer radiation: Progress report for period March 1, 1986-October 31, 1986.** Mullen, J.G. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics). Oct 1986. Contract FG02-85ER45199. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003996.

The scientific progress made during the past year can be broadly classified into three categories. First, new techniques have been found for measuring Moessbauer parameters using a microfoil conversion electron (MICE) detector. The MICE detector, coupled with high intensity sources and a LiF crystal monochromator, has permitted an accurate measurement of both the interference parameter and the lifetime of the Moessbauer isomer for the 46.5 keV transition in ^{183}W. The MICE detector has also been used in a double resonance geometry, where a conventional detector is replaced by a resonant MICE detector, to measure the temperature dependence of the recoil-free fraction for metallic tungsten. A second area where important scientific results were found was with the resonance scattering from TaS_2-1T. In addition to a sharp cusp in the inelastic scattering found just above the 80 K incommensurate to commensurate transition, a sharp discontinuity was found in the elastic and inelastic fractions of the scattered lines from the (100) primary satellites. A temperature dependence to the Debye-Waller factor was also found which is independent of the scattering wave vector, contrasting completely with the common k^2 dependence associated with phonons. High intensity Moessbauer sources have been fabricated (100 Ci) permit the k space resolution in gamma scattering comparable to an x-ray machine, while still maintaining the energy resolution of Moessbauer spectroscopy. Because of this capability, the first resolution function analysis for gamma scattering has been applied to TDS studies in silicon. 7 refs.

12862 **(DOE/ER/45200—2-10/86) Inelastic scattering in condensed matter with high intensity Mossbauer radiation: Progress report for period March 1, 1986-October 31, 1986.** Yelon, W.B.; Schupp, G. (Missouri Univ., Columbia (USA). Research Reactor Facility). Oct 1986. Contract FG02-85ER45200. 12p. NTIS, PC A02/MF A01; 2; GPO Dep. File Number DE87003379.

The scientific progress made during the past year can be broadly classified into three categories. First, new techniques were found for measuring Mossbauer parameters using our microfoil conversion electron (MICE) detector. The MICE detector, coupled with our high intensity sources and a LiF crystal monochromator, has permitted an accurate measurement of both the interference parameter and the lifetime of the Mossbauer isomer for the 46.5 keV transition in ^{183}W. The MICE detector was also used in a double resonance geometry, where a conventional detector is replaced by a resonant MICE detector, to measure the temperature dependence of the recoil-free fraction for metallic tungsten. Signal-to-background enhancement attained by this technique for the 46.5 keV line of ^{183}W was a factor of three better than that found for an intrinsic germanium detector in transmission geometry. Secondly in the resonance scattering from TaS_2-1T in addition to a sharp cusp in the inelastic scattering found just above the 80 K incommensurate to commensurate transition, a sharp discontinuity was found in the elastic and inelastic fractions of the scattered lines from the (100) primary satellites. A temperature dependence to the Debye-Waller factor was found which is independent of the scattering wave vector, contrasting completely with the common k^2 dependence associated with phonons. The high intensity Mossbauer sources which were fabricated (100 Ci) permitted the k space resolution in gamma scattering comparable to an x-ray machine, while still maintaining the energy resolution of Mossbauer spectroscopy. The first resolution function analysis for gamma scattering was carried out and applied to TDS studies in silicon. 8 refs.

12863 **(DOE/ER/45200—T1) Inelastic scattering in condensed matter with high intensity Moessbauer radiation. Progress report, March 1-October 31, 1986.** Yelon, W.B.; Schupp, G. (Missouri Univ., Columbia (USA). Research Reactor Facility). Oct 1986. Contract FG02-85ER45200. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002122.

The scientific progress made during the past year can be broadly classified into three categories. First, new techniques for measuring Moessbauer parameters using a microfoil conversion electron (MICE) detector have been developed. Second, work has continued on resonance scattering from TaS_2-IT. Finally, a high intensity Moessbauer source has been fabricated which permits k space resolution comparable to an x-ray machine. A list of publications is included. (DWL)

12864 **(DOE/ER/53179—T5) Nuclear spin-polarized HD, D_2, HT and DT solids, liquids and high density gases: Quarterly status report No. 9, July 1, 1986-September 30, 1986.** (Syracuse Univ., NY (USA). Dept. of Physics). 30 Oct 1986. Contract FG02-84ER53179. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003385.

Testing and troubleshooting of a dilution refrigerator is reported. Efforts to obtain large and extremely pure ortho-D_2 samples and plans for future experiments are described.

12865 **(LA—10674-MS) Finite strain measures.** Cook, W.A. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 84p. NTIS, PC A05/MF A01. File Number DE87003660.

The first in a series of reports on nonlinear mechanics, this report derives, discusses, and illustrates finite strain measures. Included are deformations for configurations (or states) of a deforming body, coordinate systems to describe the configurations, and descriptions (approaches used to describe translation, rotation, and deformation). Green and Almansi strains are derived for the corotational and codeformational descriptions. Solutions of deformation example problems and comparison of the results indicate that for these two strains (1) in the case of a rectangular body with uniform extensions, they are quite different; (2) in the case of a rectangular body in simple shear, their two shearing strains are identical and their nonzero normal strains have identical magnitudes but opposite signs; (3) in the case of a cylinder, inflation and extension correspond to uniform extension whereas torsion corresponds to simple shear; and (4) in the case of longitudinal to circular beam deformation, they can be compared with uniform extension when stretch is constant in each direction. Therefore, solution of these example problems indicates that differences between Green and Almansi strains are in the normal strains and that their shearing strains are identical when differences in the normal strains are eliminated. Signorini and blank (unnamed) strains are also defined; and Green, Almansi, Signorini, blank, Biot, and logarithmic strains are all compared for a uniform extension problem. All strain measures lead to correct solutions in nonlinear mechanics when problems are formulated correctly and the constitutive relations are accurate. 12 refs., 20 figs.

12866 **(LA—10715-MS) General finite strain tensors.** Cook, W.A. (Los Alamos National Lab., NM (USA)). Dec 1986. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87003807.

This report derives, illustrates, and compares general strain tensors (or measures). General strain tensors are a generalization of the Green and Almansi strain tensors that use the reference configuration (or state) to describe the strain tensors as a linear combination of the undeformed and deformed configurations. Two different descriptions (approaches used to describe translation, rotation, and deformation) are used to derive general strain tensors: (1) the corotational, which uses material coordinates to describe the undeformed configuration; spatial coordinates to describe the deformed configuration; and reference coordinates to describe the reference configuration; and (2) the codeformational, which uses convected coordinates to describe the undeformed, deformed, and reference configurations. Because strain tensors have a set of principal axes, along which is an associated stretch (the ratio of differential lengths [deformed/undeformed]), we were able to use functions of stretch to compare strain measures. We used a uniform extension problem to illustrate the general strain tensors and to compare with other strain measures.

12867 **(LA-UR—86-3827) One-dimensional easy-plane magnets: Classical sine-Gordon theory or a quantum model?.** Wysin, G.M.; Bishop, A.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-8605199—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87002910.

From 6. CNLS annual conference on nonlinearities in condensed matter; Los Alamos, NM, USA (4 May 1986).

A classical mechanics description of one-dimensional easy-plane ferro- and antiferromagnets predicts the existence of sine-Gordon kink excitations in these systems, for the case of a small applied field within the ("strong") easy plane. Here we consider: (1) the deviations from the sine-Gordon model, due to stronger fields or weaker anisotropy, which result in modified kink properties, including negative effective masses and kink-antikink annihilation and reflection during collisions, and, (2) equilibrium thermodynamics, especially specific heat, for quantum spin S = 1/2, and S = 1 models, comparing with the predictions of classical sine-Gordon theory and with available experimental results. The applicability of a sine-Gordon model versus a quantum model or the full classical magnetic Hamiltonian is discussed, for materials such as $CsNiF_3$, CHAB [$(C_6H_{11}NH_3)CuBr_3$] and TMMC [$(CD_3)_4NMnCl_3$]. 27 refs., 7 fgis.

12868 **(LBL—21941) A molecular surface science study of the structure of adsorbates on surfaces: Importance to lubrication.** Mate, C.M. (California Univ., Berkeley (USA)). Sep 1986. Contract AC03-76SF00098. 249p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87003521.

The interaction and bonding of atoms and molecules on metal surfaces is explored under ultra-high vacuum conditions using a variety of surface science techniques: high resolution electron energy loss spectroscopy (HREELS), low energy electron diffraction (LEED), thermal desorption spectroscopy (TDS), Auger electron spectroscopy (AES), work function measurements, and second harmonic generation (SHG). 164 refs., 51 figs., 3 tabs.

12869 **Analysis of the lowest 4f→5d two-photon transition in Ce/sup 3+/:CaF_2.** Gayen, S.K.; Hamilton, D.S.; Bartram, R.H. (Department of Physics and Institute of Materials Science, University of Connecticut, Storrs, Connecticut 06268). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 7517-7523(1 Dec 1986).

A theoretical estimate of the two-photon absorption (TPA) cross section for the lowest 4f→5d zero-phonon transition in Ce/sup 3+/:CaF_2 is presented. A point-charge crystal-field model is used to calculate the odd component of the C_4/sub v/ crystal field which mixes states of opposite parity into the initial and final states participating in the transition. The sum over intermediate states is evaluated by assuming a constant energy denominator and using a closure approximation. The calculated magnitude and polarization anisotropy of the TPA cross section are compared with the experimentally measured values and methods to improve the calculation are discussed.

12870 **Effective interactions for self-energy. I. Theory.** Ng, T.K.; Singwi, K.S. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 7738-7742(1 Dec 1986).

A systematic way of deriving effective interactions for self-energy calculations in Fermi-liquid systems is presented. The self-energy expression contains effects of density and spin fluctuations and also multiple scattering between particles. Results for arbitrarily polarized one-component Fermi-liquid systems and unpolarized two-component systems are explicitly given.

12871 **Effective interactions for self-energy. II. Application to electron and electron-hole liquids.** Ng, T.K.; Singwi, K.S. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 7743-7747(1 Dec 1986).

Effective masses in an electron gas and an electron-hole liquid are calculated for different values of r/sub s/ and of the ratio M/sub h//M/sub e/ (in the case of the electron-hole liquid) using the self-energy expressions derived in the preceding paper [Ng and Singwi, Phys. Rev. B 34, 7738 (1986)]. In the case of an electron gas, it is found that spin-fluctuation effects lead to an appreciable amount of mass enhancement for metallic r/sub s/ values, whereas in the case of an electron-hole liquid, both spin and density fluctuations are important in determining the quasiparticle properties.

12872 **Microcanonical simulation of the three-dimensional random-field Ising model.** Arian, Y.; Shapir, Y. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973 and Department of Physics, State University of New York, Stony Brook, New York 11794). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 8133-8136(1 Dec 1986).

Results of large microcanonical simulations of the three-dimensional random-field Ising model are reported, including the distribution of local magnetizations. Domains are shown to be formed already above T/sub c/. The apparent behavior near the critical point, strongly affected by divergent relaxation times, varies with the random-field excess. For some realizations the sudden flip of a large domain appears as a discontinuous transition.

12873 **Predicting new solids and superconductors.** Cohen, M.L. (Univ. of California, Berkeley). *Science (Washington, D.C.);* **234**: 549-553(31 Oct 1986). Contract AC03-76SF00098.

It is now possible to start with a simple model of a solid composed of atomic cores and itinerant valence electrons and compute the total energy for a given structural arrangement of atoms with enough precision to predict the existence of new solids and their properties. The application of the model based on the pseudopotential method is described with silicon chosen as a prototype material. With only information about the constituent atoms, the electronic, structural, vibrational, and even superconducting properties of solids can be calculated from first principles. The successful predictions of superconductivity in highly condensed hexagonal silicon and the existence of new high-pressure semiconductor phases are highlighted. A discussion is presented of the use of the method to discover new stable or metastable solids at high pressures.

12874 **Circular intensity differential scattering measurements of planar and focal Conic orientations of cholesteric liquid crystals.** Hall, K.; Keller, D.; Samori, B.; Wells, K.S. (Univ. of California, Berkeley, CA). pp 77-91 of Applications of circularly polarized radiation using synchrotron and ordinary sources. Allen, F.; Bustamante, C. New York, NY; Plenum Press (1985). (CONF-8405239—).

From Workshop on applicatons of circularly polarized synchrotron radiation; Albuquerque, NM, USA (18 May 1984).

The authors have applied the technique of circular intensity differential scattering (CIDS) to the study of oriented liquid crystals. The chirality of manipulation of their helical parameters make them an ideal system for investigating the dependence of the CIDS pattern on handedness and pitch. The authors have studied both right- and left-handed liquid crystals of pitch from 460 nm to 4 microns, with the helix axis oriented either parallel (planar orientation) or perpendicular (focal conic orientation) to the incident beam. The results showed that CIDS is sensitive to the handedness of the helix, for when two liquid crystals of the same pitch but opposite handedness were compared, the signs of their respective CIDS patterns were reversed.

12875 **Stress concentrations due to sliding grain boundaries in creeping alloys.** Lau, C.W.; Argon, A.S.; McClintock, F.A. (Massachusetts Institute of Technology, Cambridge). *American Society for Testing and Materials, Special Technical Publication;* **1**: I.551-I.571(1984). Contract AC02-77ER04461.

The most dominant singular stress distributions caused by grain-boundary sliding accommodated by power-law creep have been determined at hard grain-boundary particles and at triple grain junctions, where cavitation and eventual creep cracking are frequently observed. Finite element computations have been used to connect these local stresses to the far-field stresses. These finite element analyses incorporate a specially formulated power-type singularity element, a new method of simulating periodicity and symmetry boundary conditions, a scheme for automatic variable step selection for stable time integration, and a method to bypass the influence of incompressibility. The deviatoric stresses obtained from the finite element results show very good agreement with the dominant singularity solutions, and provide accurate estimates of the generalized stress intensity factors. 22 references, 14 figures, 1 table.

12876 **Wavepacket approach to gas-surface scattering: application to surfaces with imperfections.** Drolshagen, G.; Heller, E.J. (Los Alamos National Lab., NM). *Surface Science;* **139**: 260-280(1984).

A time dependent wavepacket approach is applied to diffractive scattering from surfaces with imperfections. This semiclassical method is based on Gaussian wavefunctions whose average positions and momenta are those of classical trajectories. The approach can be applied to arbitrary potentials. Positions, shapes and magnitudes of the diffraction peaks are obtained in a single calculation. In a first example the wavepacket method is applied to a stepped surface. The diffraction pattern is calculated for different incident scattering angles and for various regular and random distributions of steps with two different incident scattering angles and for various regular and random distributions of steps with two different sizes. Second, the approach is used to study the scattering for an interaction potential modeling a corrugated surface with adsorbed atoms. The diffraction intensities are examined for several final scattering directions and again for regular and random arrangements of the adsorbed atoms. 27 references, 8 figures.

12877 **Vibrational and configurational contributions to the thermodynamics of metallic solutions.** Williams, R.O. (Oak Ridge National Lab., TN). *CALPHAD: Computer Coupling of Phase Diagrams and Thermochemistry;* **8**: No. 2, 135-148(1984). Contract W-7405-ENG-26.

The authors have developed a solution model for the thermodynamics of metallic systems that is composed of three contributions beyond the regular solution model. The contribution due to the nonrandomness is based upon a two-term expansion of the Guggenheim statistical mechanical model. There is a vibrational contribution that is treated as being an alloying effect on the Debye temperature. In fitting this model to the data in Hultgren et al. it was necessary to include a third term that represented a bias, the precise nature of which could not be determined. It was possible to select fixed values for the three parameters that represent these effects, along with an individual interaction energy for each system, that provided a satisfactory fit of the majority of the solution data in Hultgren et al. 32 references, 7 figures, 1 table.

12878 **Complex J-integral and Peach-Koehler equation.** Chang, S.J. (Union Carbide Corp., Oak Ridge, TN). *International Journal of Fracture;* **16**: R79-R82(1980). Contract W-7405-ENG-26.

Budiansky and Rice derived the J-integral in terms of the complex stress functions phi(z) and psi(z). It is convenient for calculating the force on an elastic singularity or the energy release rate for a crack if the problem is solved by the method of complex variables. In the present paper it is shown how the Peach-Koehler equation for the force acting on a dislocation can be obtained by the complex J-integral. It is then applied to the crack model of Bilby, Cottrell, and Swinden (BCS model) to show that the J-integral of this model is equal to the sum of all forces on the dislocations which are distributed within the plastic zone. Material properties such as work hardening and rate dependence enter only if the authors are concerned with the fracture criterion. 3 references.

6561 Superconductivity

REFER ALSO TO CITATION(S) 11609

12879 **Josephson current in low-dimensional proximity systems and the field effect.** Kresin, V.Z. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **34**: No. 11, 7587-7595(1 Dec 1986). Contract AC03-76SF00098.

The system S/sub α/-M/sub β/-S/sub γ/ (S/sub α/ and S/sub γ/ are superconductors, M/sub β/ is a semiconductor, a semimetal, or a normal metal) is studied. Particular attention is paid to the case when M/sub β/ contains a two-dimensional electron gas (e.g., an inversion layer). A one-dimensional (1D) case is also considered. The Josephson current is evaluated and the main factors determining the field effect are studied. A special diagrammatic method allowing one to calculate the thermodynamic Green's function and, consequently, the Josephson current, has been developed. The current depends strongly on the electron concentration which leads to a noticeable field effect. The dependence of j/sub m/ on other factors, such as temperature, mobility, effect mass, etc. is also studied. The field effect appears to be stronger for low-dimensional systems. An analysis of the experimental data obtained recently for the Nb-InAs-Nb system is carried out.

12880 **Unusual temperature dependence of the upper critical field in superconducting heavy-fermion systems.** Tachiki, M.; Dunlap, B.D.; Crabtree, G.W.; Takahashi, S.; Koyama, T. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **34**: No. 11, 7603-7609(1 Dec 1986).

A new formulation of the superconducting properties of heavy-fermion metals with potentially dramatic consequences for the critical field is proposed and analyzed. The new feature of the formulation consists of including the field dependence of the normal-state properties such as the magnetic susceptibility, electronic specific heat, and electronic scattering lifetime in the calculation of the superconducting critical field. These effects are important for heavy-fermion metals because (1) the characteristic energy of the low-temperature coherent state is low, so that an applied magnetic field can appreciably alter the normal-state properties, and (2) the large effective masses lead to low Fermi velocities and high orbital critical fields, so that a significant field dependence of the normal-state properties may occur below H/sub c/$_2$. A Green's-function description of the field dependence of the normal-state properties showing how they arise from field dependence of the self-energy and vertex functions in the periodic Anderson model is given. The effect of these field-dependent normal-state properties on the superconducting critical field is calculated using a generalization of standard theory. For certain values of the parameters, the calculations predict unusually steep critical-field curves and magnetic-field-induced superconductivity, qualitatively similar to recent experimental results.

12881 **Itinerant f-electron model of heavy-fermion systems.** Kim, D.J. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **34**: No. 11, 8107-8110(1 Dec 1986).

Combining spin-fluctuation and electron-phonon interaction effects, we show that the large electron-mass enhancement and other properties of heavy-fermion metals may be understood qualitatively within a simple itinerant f-electron model.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 12597, 12609, 12615, 12673, 12830, 12867

12882 **(DOE/ER/13044—5) Connectivity properties of Mandelbrot's percolation process.** Chayes, J.T.; Chayes, L.; Durrett, R. (Cornell Univ., Ithaca, NY (USA)). Aug 1986. Contract AC02-83ER13044. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004002.

In 1974 Mandelbrot introduced a process in [0,1] which he called "canonical curdling" and later used in his book(s) on fractals to generate self-similar random sets with Hausdorff dimension D is an element of (0,2). In this paper we will study the connectivity or "percolation" properties of these sets, proving all of the claims he made in Section 23 of the "Fractal Geometry of Nature" and a new one that he did not anticipate: There is a probability p/sub c/ is an element of (0,1) so that if p < p/sub c/ then the set is "dustlike" i.e., the largest connected component is a point, whereas if p ≧ p/sub c/ (notice the =) opposing sides are connected with positive probability and furthermore if we tile the plane with independent copies of the system then there is with probability one a unique unbounded connected component which intersects a positive fraction of the tiles. More succinctly put the system has a first order phase transition. 13 refs., 7 figs.

12883 **(DOE/ER/13044—7) Painleve property and integrability.** Ercolani, N.; Siggia, E.D. (Arizona Univ., Tucson (USA). Dept. of Mathematics; Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). 13 Jan 1987. Contract AC02-83ER13044. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004003.

For an n-degree of freedom hyperelliptic separable Hamiltonian, the pole series with n + 1 free constants, through the Hamilton-Jacobi equation, bounds the degrees of the n-polynomials in involution. When all the pole series have no fewer than 2n constants, the phase space is conjectured to be just the direct product of 2n complex lines cut out by (2n-1) integrals. 14 refs.

12884 **(DOE/ER/25009—354) Minimization by simulated annealing: Is detailed balance necessary.** Williams, R.D. (California Inst. of Tech., Pasadena (USA)). 1986. Contract AC03-81ER40050;FG03-85ER25009. 18p. (CALT—69-1407). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003560.

We consider a Hamiltonian which is derived from the design of a load-balancer for parallel computers, and which is also the Potts model with an extra term which equalizes the proportion of each Potts state. We find the global minimum of the Hamiltonian using simulated annealing (SA), and by two similar methods which do not satisfy detailed balance. The first method biasses the system toward the minimum, and finds the global minimum about 20 times faster than SA; the second method is much easier to implement on a parallel computer than SA, and results in slight degradation of performance over SA. 8 refs., 5 figs.

12885 **(DOE/ET/13146—2) Investigations of transitions from order to chaos in dynamical systems: Progress report.** Schmidt, G. (Stevens Inst. of Tech., Hoboken, NJ (USA). Dept. of Physics). Dec 1986. Contract AC02-84ER13146. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003795.

Dynamical systems were investigated using analytical, computational and experimental methods. The systems studied could be represented by two dimensional dissipative maps or nonlinear differential equations representing flow in some three dimensional phase space. It was found that a large class of these systems exhibits universal characteristics. These characteristics involve not only universal period doubling routes to chaos, but universal properties of the strange attractors representing chaotic behavior. These results were anticipated by laboratory and computer experiments and confirmed finally by renormalized theory. In this class of systems strange attractors, their crises, fractal dimension, Liapunoff exponents show universal behavior as the strength parameter and dissipation is varied. 17 refs.

12886 **(IAE—4094/1) Solitons and theory of representations.** Kulish, P.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700318.

Problems on the theory of group representations finding application in constructing the quantum variant of the inverse scattering problem are discussed. The multicomponent nonlinear Shroedinger equation is considered as a main example of nonlinear evolution equations (NEE). 19 refs.

12887 **(IFVE-OTF—85-133) Relativistic gravitation theory and graviton rest mass.** Logunov, A.A.; Mestvirishvili, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700321.

Submitted to the journal Theor. Math. Phys. .

The graviton rest mass m has been introduced. The equations describing a massive gravitational field have been obtained in the framework of the RTG. Assuming the whole "hidden mass" of matter in the Universe to be due to the existence of a massive gravitational field, we obtain the upper bound on m: m < or approximately 0.64 x 10sup(-65) g. 5 refs.

12888 **(IFVE-OTF—85-162) Relativistic theory of gravity.** Logunov, A.A.; Mestvirishvili, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 67p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87700322.

This work presents an unambiguous construction of the relativistic theory of gravity (RTG) in the framework of relativity and the geometrization principle. The gauge principle has been formulated, and the Lagrangian density of the gravitational field has thus

been constructed. This theory explains the totality of the available experimental data on the solar system and predicts the existence of gravitational waves of the Faraday-Maxwell type. According to the RTG, the Universe is infinite and "flat", hence it follows that its matter density should be equal to its critical density. Therefore, an appreciable "hidden mass" exceeding the presently observed mass of the matter almost 40-fold should exist in the Universe in some form of the matter or other. In accordance with the RTG, a massive body having a finite density ceases to contract under gravitational forces within a finite interval of proper time. From the viewpoint of an external reference frame, the brightness of the body decreases exponentially (it is getting darker), but nothing extraordinary happens in this case because its density always remains finite and, for example, for a body with the mass of about 10^8 M_0 it is equal to 2 g/cm^3. That is why it follows from the RTG that there could be no object whatsoever (black holes) in which gravitational collapse of matter develops to an infinite density. As has been shown, the presence of a cosmological term necessarily requires the introduction of a term with an explicit dependence on the Minkowski metrics. For the long-range gravitational forces the cosmological constant vanishes. 24 refs.

12889 (INIS-SU—365, pp 35-40) **Inverse problem for axial-deformed potentials.** Zakhar'ev, B.N.; Funke, Kh. 1985. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780050. (N—12-85).

In JINR rapid commutations. Collection.

In the literature about Inverse Problems there are no tractable methods for construction of nonspherical potentials from the asymptotic wave function. This problem turned out to be solved in special cases. The methods of reconstruction from scattering data are given for the class of potentials admitting the separation of variables in spheroidal coordinates. This is the first case when the agorithms of the inverse problem solution for spherically-nonsymmetrical local potentials can practically be realised. The modifications of the formalisms of Regge-Newton-Sabatier and finite-difference approximation of Hooshyar-Rasavy are considered.

12890 (INIS-SU—365) **JINR rapid commutations. Collection.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1985. 58p. (In Russian). (N—12-85). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780050.

The individual papers for this meeting have been abstracted separately.

12891 (ITF—85-85-R) **Normal gauge in N=1 supergravity.** Bandos, I.A.; Zima, V.G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700323.

Normal gauge is fixed on the embedding functions and compensators for all known kinds of N=1 supergravity as well as for its new formulation with auxiliary superfield. As the simplest application the superfield equations of motion for all kinds of simple supergravity are derived by varying the action of the new formulation. Gauges in curved real superspace are considered, too. 24 refs.

12892 (ITF—85-95-R) **Functional determinants and effective action for conformal scalar and spinor fields in external gravitational field.** Bukhbinder, I.L.; Gusynin, V.P.; Fomin, P.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700351.

A method for evaluating the functional determinants of some differential operators in quantum field theory is developed. It is shown that the ratios of two determinants for conformally connected metrics and for conformal matter fields are calculated in explicit form. 29 refs.

12893 (JINR—E-4-85-525) **Representations which satisfy identities associated with tensor operators. Second-degree tensor operators which transform under the representations (2ΛY) of so(2n,c) and (Λ_2) of sp(2n,c).** Iosifescu, M.; Scutaru, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Institutul Central de Fizica, Bucharest (Romania)). 1985. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700317.

In previous works a method has been pointed out for the determination of all polynominal identities which can be satissfied by the generators xsub(i) of representations p of a Lie algebra. These identities are Tsub(σ)sup((k)) (x_1, ..., xsub(n))=0, where Tsub(σ)sup((k)) (x_1, ..., xsub(n)) is a tensor operator transforming under the subrepresentation σ of (ad x k)sub(s). The present work determines the representations p for which Tsub($2\Lambda_1$)sup(2)9(p)=0 for so(2n, c) and Tsub(Λ_3)sup(2(2)) (p)=0 for sp(2n, c). They result from the condition Tsub(σ)sup((2)) (p)vsub(p)=0 (vsub(p)=highest weight vector of p). It is proved that in the first case p=(kΛsub(n-1)) or p=(kΛsub(n)) and that in the second p=(kΛsub(n)). Equations for vsub(p) are also determined. 26 refs.

12894 (JINR—E-4-85-705) **Open quantum system and the damping of collective modes in deep inelastic collisions.** Sandulescu, A.; Scutaru, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Institutul Central de Fizica, Bucharest (Romania)). 1985. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700319.

In the framework of the Lindblad theory for open quantum systems the following results are obtained: a generalization of the fundamental constraints on quantum mechanical diffusion coefficients which appear in the corresponding master equations, a generalization of pure state condition and generalized Schrodinger type nonlinear equation for an open system. Also, the Schroedinger, Heisenberfg and Weyl-Wigner-Moyal representations of the Lindblad equation are given explicitly. On the basis of these representations, it is shown that various master equations for the damped quantum oscillator used in the literature for the description of the damped collective modes are particular cases of the Lindblad equation and that the majority of these equations are not satisfying the constraints on quantum mechanical diffusion coefficients. The solutions of the differential equations for the variances are put in a new synthetic for, suggested by a direct computation of the variances from the time dependent Weyl operators. The solution of the Lindblad equation in the Weyl-Wigner-Moyal representation is of Gaussian type if the initial form of the Wigner function is taken to be a Gaussian corresponding to a coherent wave furction. 49 refs.

12895 (UWThPh—86-26) **Stochastic quantization of gravity and string fields.** Rumpf, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700324.

The stochastic quantization method of Parisi and Wu is generalized so as to make it applicable to Einstein's theory of gravitation. The generalization is based on the existence of a preferred metric in field configuration space, involves Ito's calculus, and introduces a complex stochastic process adapted to Lorentzian spacetime. It implies formally the path integral measure of DeWitt, a causual Feynman propagator, and a consistent stochastic perturbation theory. The lineraized version of the theory is also obtained from the stochastic quantization of the free string field theory of Siegel and Zwiebach.

12896 (UWThPh—86-27) **Level comparison theorems and supersymmetric quantum mechanics.** Baumgartner, B.; Grosse, H.; Martin, A. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik; European Organization for Nuclear Research, Geneva (Switzerland)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700320.

The sign of the Laplacian of the spherical symmetric potential determines the order of energy levels with the same principal Coulomb quantum number. This recently derived theorem has been generalized, extended and applied to various situations in particle, nuclear and atomic physics. Besides a comparison theorem the essential step was the use of supersymmetric quantum mechanics. Recently worked out applications of supersymmetric quantum mechanics to index problems of Dirac operators are mentioned.

12897 (UWThPh—86-28) **Exact superpartners of N = 2 supergravity solitons.** Aichelburg, P.C.; Embacher, F. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700325.

By applying long-range N = 2 supergauge transformations to the Majumdar-Papapetrou configurations, the set of all superpartners to the bosonic multi-solitons is exhibited. The resulting configuration is parametrized by two additional complex Grassmann numbers. Apart from mass and electric (possibly magnetic) charge it carries a supercharge which is algebraically constrained due to the central charges in the supersymmetry algebra. The supercharge gives rise to an 'intrinsic' angular momentum. Similar to the Kerr metric, the configuration is stationary with an anomalous magnetic moment.

12898 **Quantum Monte Carlo.** Ceperley, D.; Alder, B. (Lawrence Livermore National Lab., CA). *Science (Washington, D.C.);* **231**: 555-560(7 Feb 1986). Contract W-7405-ENG-48.

An outline of a random walk computational method for solving the Schroedinger equation for many interacting particles is given, together with a survey of results achieved so far and of applications that remain to be explored. Monte Carlo simulations can be used to calculate accurately the bulk properties of the light elements hydrogen, helium, and lithium as well as the properties of the isolated atoms and of molecules made up from these elements. It is now possible to make reliable predictions of the behavior of these substances under experimentally difficult conditions, such as high pressure, and of properties that are difficult to measure experimentally, such as the momentum distribution in superfluid helium. For chemical systems, the stochastic method has a number of advantages over the widely used variational approach to determine ground-state properties, namely fast convergence to the exact result within objectively established error bounds. 37 references 4 figures.

12899 **Relationship between supersymmetry and the inverse method in quantum mechanics.** Nieto, M.M. (Los Alamos National Lab., NM). *Physics Letters [Section] B;* **145B**: No. 3-4, 208-210(20 Sep 1984).

In supersymmetric QM the bosonic hamiltonian H/sub +/ = A dagger A yields the fermionic hamiltonian H/sub -/ = AA dagger. However, the most general B/sub λ/ that satisfies B/sub λ/ B/sub λ/ dagger = H/sub -/ yields an H/sub B+/(λ) = B/sub λ/ dagger B/sub λ/ which in general is not H/sub +/. This new hamiltonian can be understood as a special case of the application of the inverse method to H/sub +/ to obtain new hamiltonians, one of which is H/sub B+/(λ). When λ = 0 the new hamiltonian has the original bosonic spectrum but with the ground state removed. 11 references, 1 table.

12900 **Theorem about Hamiltonian systems.** Case, K.M. (Rockefeller Univ., New York, NY). *Proceedings of the National Academy of Sciences of the United States of America;* **81**: 5893-5895(Sep 1984). Contract AC02-81ER10807.

A simple theorem in Hamiltonian mechanics is pointed out. One consequence is a generalization of the classical result that symmetries are generated by Poisson brackets of conserved functionals. General applications are discussed. Special emphasis is given to the Kadomtsev-Petviashvili equation. 5 references.

12901 **Mechanism for the generation of cavitation maxima by pulsed ultrasound.** Flynn, H.G.; Church, C.C. (Univ. of Rochester, NY). *Journal of the Acoustical Society of America;* **76**: No. 2, 505-512(Aug 1984). Contract AC02-76EV03490.

A train of 1-MHz pulses can generate maxima of cavitation activity at pulse lengths of 6 and 60 ms and at pressure amplitudes, P/sub A/, between 5.4 and 9.4 bars (or intensities between 10 and 30 W/cm^2). Generation of maxima at P/sub A/ between these limits on pressure amplitude implies that the increase in cavitation activity originates from gas nuclei with radii lying in a critical size range centered at about 0.08 μm. The mechanism proposed for this phenomenon suggests that nuclei in this critical range are unstabilized nuclei generated in one pulse and surviving to the next with an appreciable fraction of the survivors lying in the critical range. Transient cavities that grow from such small nuclei are shown to behave as isolated mechanical systems that on reaching maximum size collapse as imploding spheres. The maximum pressures reached in such imploding cavities would then approximate those calculated for the spherical collapse of cavities. The occurrence of the observed maxima is ascribed to the spherical collapse of transient cavities. 17 references, 5 figures.

12902 **Polynomial constants for the quantized NLS equation.** Case, K.M. (Rockefeller Univ., New York, NY). *Journal of Mathematical Physics (New York);* **25**: No. 7, 2306-2314(Jul 1984). Contract AC02-81ER10807.

The classical nonlinear Schroedinger equation (NLS) is known to have an infinite number of polynomial constants. While recursion relations to compute these are available, no general expressions in terms of the fields have been found. However, general expressions have been obtained in terms of the reflection coefficients. When one turns to the quantum case where the fields become operators with conventional commutation relations, the polynomials with suitable ordering are still constants. The classical expression for the constants in terms of the reflection coefficients strongly suggests what the quantum form should be. This conjecture is proved for the repulsive case. The expression is significantly simpler than the classical one. It is I/sub n/ = (1/2 π) integral/sub ∞//sup ∞/ (k)/sup n/ R *(k) R (k)dk. 6 references.

12903 **Abstract kinetic equations relevant to supercritical media.** Greenberg, W.; van der Mee, C.V.M. (Universita degli Studi di Firenze, Florenze, Italy). *Journal of Functional Analysis;* **57**: No. 2, 111-142(15 Jun 1984). Contract AS05-80ER10711.

The abstract Hilbert space equation is studied with a partial range boundary condition. This models half-space stationary transport problems in supercritical media. A complete existence and uniqueness theory is developed. 35 references.

12904 **Analysis of a multigrid method as an iterative technique for solving linear systems.** Greenbaum, A. (Lawrence Livermore National Lab., CA). *SIAM (Society for Industrial and Applied Mathematics) Journal on Numerical Analysis;* **21**: No. 3, 473-485(Jun 1984). Contract W-7405-ENG-48.

A general class of iterative methods is introduced for solving symmetric, positive definite linear systems. These methods use two different approximations to the inverse of the matrix of the problem, one of which involves the inverse of a smaller matrix. It is shown that the methods of this class reduce the error by a constant factor at each step and that under ideal circumstances this constant is equal to (k' - 1)/(k' + 1), where k' is the ratio of the largest eigenvalue to the (J + 1)st eigenvalue of the matrix, J being the dimension of the smaller matrix involved. A multigrid method is presented as an example of a method of this class, and it is shown that while the multigrid method does not quite achieve this optimal rate of convergence, it does reduce the error at each step by a constant factor independent of the mesh spacing h. The size of this constant factor and properties of the differential equation and the discretization that affect it are also discussed. 5 references, 1 table.

12905 **Logarithmic perturbation expansions in nonrelativistic quantum mechanics.** Imbo, T.; Sukhatme, U. (Univ. of Illinois, Chicago). *American Journal of Physics;* **52**: No. 2, 140-146(Feb 1984). Contract AC02-83ER40110.

The authors discuss an alternative method of performing coupling constant perturbation expansions in nonrelativistic quantum mechanics. This method, called logarithmic perturbation theory, yields new expressions for any-order corrections E/sub n/ to an unperturbed bound-state energy which do not involve cumbersome sums over intermediate unperturbed states. In one dimension, these corrections E/sub n/ can be evaluated using a simple explicit form containing a small number of integrals. In more than one dimension the approach is systematic but computations require the solution of well-defined partial differential equations. For order n = 2 this equation is identical to that appearing in the method of Dalgarno and Lewis. Numerous illustrative examples are presented. 5 references.

12906 **Stochastic analysis of explosive behavior: a qualitative approach.** Frankowicz, M.; Mansour, M.M.; Nicolis, G. (Universite Libre de Bruxelles, Belgium). *Physica A (Amsterdam);* **125A**: 237-246(1984). Contract AS05-81ER10947.

In many instances, the evolution of physico-chemical systems involves a long slow induction period followed by an abrupt switching to a final stable attractor. In the present paper the properties of fluctuations during this explosive stage of evolution are analyzed. Qualitative arguments, confirmed by an exactly soluble model, establish that this regime is characterized by the development of long tails and multiple humps in the probability distribution. The implications of this phenomenon of transient bimodality are discussed. 12 references, 3 figures.

12907 **Stationary transport processes with unbounded collision operators.** Greenberg, W.; Van Der Mee, C.V.M. (Universita degli Studi di Firenze, Italy). *Letters in Mathematical Physics;* 8: 7-12(1984). Contract AS05-80ER10711.

An abstract Hilbert space equation is studied, which models many of the stationary, one-dimensional transport equations with partial-range boundary conditions. In particular, the collision term may be unbounded and nondissipative. A complete existence and uniqueness theory is presented. 18 references.

12908 **Models of disordered media: some new results, including some new connections between composite-media, fluid-state, and random-flight theories.** Stell, G. (State Univ. of New York, NY). pp 347-369 of Lecture notes in mathematics. Dold, A.; Eckmann, B. (eds.). New York, NY; Springer-Verlag (1983).

Some new theoretical results on the microstructure of models of two-phase disordered media are given, as well as the new quantitative bounds on the thermal conductivity that follows for one such model (randomly centered spherical inclusions). A second set of results is then given for random flights, including random flights with hit expectancy prescribed in a unit hall around the flight origin. Finally, some interesting correspondences are demonstrated, via the Ornstein-Zernike equation, between random-flight results, liquid-state results and percolation-theory results. 27 references, 6 figures, 4 tables.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 11441

12909 **(DOE/ER—0297) Magnetic fusion energy research: A summary of accomplishments.** (USDOE Office of Energy Research, Washington, DC. Office of Program Analysis). Dec 1986. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004222.

Some of the more important contributions of the research program needed to establish the scientific and technical base for fusion power production are discussed. (MOW)

7001 Plasma Research

REFER ALSO TO CITATION(S) 12212, 12587, 12598, 12664

12910 (CONF-8510176—, pp 24-29) **New Hamiltonian methods in gyrokinetic plasma theory.** Frieman, E.A.; Hagan, W.K. (Science Applications International Corp., La Jolla, CA). 1985. NTIS, PC A13/MF A01. File Number DE86005973.

From 3. symposium on energy engineering sciences: thermofluids and solid mechanics; University Park, PA, USA (8 Oct 1985).

The application of the direct interaction approximation (DIA) to turbulent systems in which multi-time and -space scales exist is discussed. These different scales can be exploited to perform an asymptotic expansion of the dynamical governing equations prior to the application of the DIA. Based on a cursory examination of the Navier-Stokes equation, it is conjectured that such an approach may resolve some of the problems associated with the DIA. The problem of anomalous transport in tokamak fusion plasmas is another example of a problem which might benefit from such an approach. A new Hamiltonian method for deriving the nonlinear gyrokinetic equations which govern this system is discussed and shown to resolve many of the issues introduced by the recent application of Hamiltonian methods to this problem. This is followed by a reformulation of the DIA for systems in which there are two governing equations, instead of the usual one.

12911 **(DOE/ER/53161—1) Theoretical study of the trapping of relativistic electron beams in tokamaks for current drive: Final scientific report, 1 September 1983-1 August 1984.** Kusse, B.R.; Lovelace, R.V.E. (Cornell Univ., Ithaca, NY (USA)). [1985]. Contract AC02-83ER53161. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003358.

During this contract period we have addressed two areas of merging and trapping by looking at magnetic reconnection and equilibrium. Magnetic reconnection must occur if the beam and plasma channel are to merge. This reconnection can be driven by the self attraction of the beam and plasma current channels or a combination of the self attraction and an externally driving coal as was done in the Cornell experiments. The reconnection time will obviously play a large role in determining the time it takes for the electron beam particles to reach the minor axis. Sustained trapping of the beam particles depends upon establishing a stable equilibrium configuration in which the electron distribution has a high energy component.

12912 **(DOE/ER/53196—T5) Rf effects on plasma stability: Final report.** Krall, N.A. (JAYCOR, San Diego, CA (USA)). Dec 1986. Contract AC03-85ER53196. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004130.

A program of study on the effect of high frequency waves on low frequency stability of plasma was concluded. The inclusion of electromagnetic modes completed the survey of mode types and wave number geometry, and a calculation in cylindrical geometry validated the slab model calculations. Application of the method to drift and trapped particle instabilities confirmed the relevance of rf processes to tokamaks and ionospheric plasmas, in addition to the mirror devices for which they were originally explored.

12913 **(DOE/ER/53211—122) Advanced development of particle beam probe diagnostic systems: Technical progress report covering the period 10 December 1985-30 November 1986.** Hickok, R.L.; Jennings, W.C.; Connor, K.A.; Crowley, T.P. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Dec 1986. Contract FG02-85ER53211. 13p. NTIS MF A01; 2; GPO Dep. File Number DE87003572.

During the period covered by this report, significant progress was made in: (1) Demonstrating fast continuous T/sub e/ measurements by simultaneous observations of both 2^+ and 3^+ secondary ions. (2) Improving the techniques for simultaneous measurements of the k and ω spectra for both n-tilde and phi-tilde. (3) Developing new procedures for processing fluctuation data that improves the extraction of weak coherent signals in the presence of strong wideband fluctuations. (4) Identifying both the capabilities and the necessary technological development required to implement beam probes or reactor size systems, and (5) improving the technology of present day systems.

12914 **(DOE/ER/53223—17) Self-excitation of the ballooning tearing mode and the nature of anomalous transport in toroidal magnetic confinement systems.** Zakharov, L.E.; Riedel, K.S. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Aug 1986. Contract FG02-86ER53223. 19p. (MF—111). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003419.

The self-excitation of the ballooning tearing mode in toroidal systems with strong magnetic fields is discovered. This instability is driven by the pressure gradient at small islands and arises from the coupling of poloidal harmonics. This instability is always unstable with respect to perturbations of finite size. In our opinion, it is the main mechanism for plasma turbulence and therefore defines the energy confinement time in tokamaks and stellarators.

12915 **(DOE/ER/53227—99) Trapping of gun-injected plasma by a tokamak.** Leonard, A.W.; Dexter, R.N.; Sprott, J.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). Oct 1986. Contract FG02-86ER53227. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004147.

It is shown that a plasma produced by a Marshall gun can be injected into and trapped by a tokamak plasma. Gun injection raises the line-averaged density and peaks the density profile. Trapping of the gun-injected plasma is explainable in terms of a depolarization current mechanism. A model is developed which describes the slowing of a plasma beam crossing into the magnetic field of a tokamak. The slowing down time is shown to go as tau/sub s/ $\propto$ n^{-1}/sub b/T^{3}/sub e/$(a_0/L)^{2}$, where n/sub b/ and T/sub e/ are the density and temperature of the plasma beam and a_0/L is the pitch of the field lines per unit length in the direction in which the beam is traveling. Experimental tests of this model are consistent with the scaling predictions.

12916 **(DOE/ER/53227—100) The trapping of a gun-injected plasma by a tokamak.** Leonard, A.W. (Wisconsin Univ., Madison (USA). Dept. of Physics). Oct 1986. Contract FG02-86ER53227. 101p. NTIS, PC A06/MF A01. File Number DE87004146.

A Marshall gun was used to refuel a tokamak discharge on the Tokapole II device. Gun injection was able to increase the line-averaged density of the discharge by 50%. The density profile became more peaked due to gun injection. A model is discussed which describes the trapping of a gun injected plasma in a pure octupole field, due to a depolarization current. This model is expanded to include arbitrary toroidal fields added to the poloidal field. A slowing time, tau/sub s/, is derived for the trapping of an injected plasma of density n/sub b/, and temperature, T/sub e/, into poloidal field, B/sub p/ and toroidal field, B/sub t/. The experiment is extended to the tokamak discharge by the addition of plasma density and current to the vacuum fields, B/sub p/ and B/sub t/. Plasma density is seen to not significantly affect trapping. The increase in trapping with plasma current is explained in terms of additional poloidal field added to the central current channel. An extrapolation is made of the refueling system to the reactor-size tokamak TFTR. An effective system seems easily obtainable.

12917 **(DOE/ET/53193—6) Heating and current-drive with high phase velocity compressional Alfven waves.** Li, Y.M.; Mahajan, S.M.; Ross, D.W. (Texas Univ., Austin (USA). Fusion Research Center). Dec 1986. Contract AC05-76ET53036;AS05-85ER53193. 33p. (FRC—293). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004317.

It is shown that high phase velocity compressional Alfven waves have the desirable features needed for efficient current drive in fusion-reactor-like conditions; the energy deposition is low on the α-particles, and high on the hot electrons in the plasma interior.

12918 **(GTFR—67) Analysis of neutral beam driven impurity flow reversal in PLT.** Malik, M.A.; Stacey, W.M. Jr.; Thomas, C.E. (Georgia Inst. of Tech., Atlanta (USA). Fusion Research Center). Oct 1986. Contract AS05-78ET52025. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003565.

The Stacey-Sigmar impurity transport theory for tokamak plasmas is applied to the analysis of experimental data from the PLT tokamak with a tungsten limiter. The drag term, which is a central piece in the theory, is evaluated from the recently developed gyroviscous theory for radial momentum transfer. An effort is made to base the modeling of the experiment on measured quantities. Where measured data is not available, recourse is made to extrapolation or numerical modeling. The theoretical and the experimental tungsten fluxes are shown to agree very closely within the uncertainties of the experimental data.

12919 **(IAE—4051/16) Computer code for calculating tearing instability in a tokamak.** Chudnovskij, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1984. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700358.

A code for modelling of mutual effect of transport processes and tearing instability in a tokamak is described. Equations and formulae of the tearing-mode dynamics are presented. Peculiarities of software are described. Calculations have shown the correspondance of calculated tearing mode with experimental regimes and developed magnetic hydrodynamic activity. An example of calculation results output on curve plotter is presented. 16 refs.; 5 figs.

12920 **(IAE—4089/7) Energy confinement in a plasma of the T-13 tokamak under variation of plasma filament large radius.** Abramov, A.V.; Belashov, V.I.; Bortnikov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700353.

Investigation results of the dependence of energy confinement time tau in elctron component of the plasma filament on large radius R at joule heating of plasma in T-13 tokamak are presented. Small filament radius is a<=8.5 sm, large radius changed within the range of 46<=R<=81 sm. tau dependence on R has not been found in given experiments. The obtained tau value has been compared with a number of known scalings for confinement time. 9 refs.; 8 figs.

12921 **(IAE—4100/7) Diagnostics of ultrasoft X radiation of a dense thermonuclear plasma by means of vacuum photoemission detectors.** Aranchuk, L.E.; Bogolyubskij, S.L.; Tel'kovskaya, O.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700355.

Diagnostics, designed for investigating dense plasma radiation in the spectrum region of 0.01 keV <= E < 10 keV, is described. Design and characteristics of vacuum photoemission detectors, used for plasma X radiation detection, are described. The measurement results of absolute energy spectra of plasma channel radiation are given, the channels being formed during explosion of thin wires in the diode of a heavy-current generator. 14 refs.; 10 figs.; 2 tabs.

12922 **(IAE—4130/6) Simulation of collective transfer in a toroidal plasma.** Gribkov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700359.

Plasma drift in magnetic configurations with the separatrix is considered. Drift patterns and the coefficient of plasma diffusion in such configurations are calculated. Estimation of transfer coefficients and their comparison with the results of a local theory are carried out. The equation for small nonpotential oscillations of dissipative balloon modes is solved. The balloon modes at finite conductivity are shown to lead to pseudoclassical transfers. A nonlinear model of fishbone oscillations is simulated; it reflects main qualitative features of the phenomenon observed during the experiment. 27 refs.; 16 figs.

12923 **(INPE—3810) Graphical study of electromagnetic wave accessibility in tokamak plasmas near the electron-cyclotron frequency.** Shibata, C.S.; Montes, A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Feb 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700360.

The accessibility of electron frequency range electromagnetic waves in magnetized inhomogeneous tokamak plasmas is studied using the cold plasma model. Simple equations for cutoff and resonance surfaces are obtained for parabolic density profile plasma. Using cartesian coordinates in the poloidal cross section of the tokamak, these equations are arranged in a convenient standard form, in order to facilitate the plotting of the various surfaces simultaneously. Graphical outputs for several cases are presented, together with the principal cutoff and resonance frequency profiles along the minor radius.

12924 **(INPE—3914) Steady state behavior of rotating plasmas in a vacuum-arc centrifuge.** Bittencourt, J.A.; Ludwig, G.O. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jun 1986. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87700357.

The steady state behavior of the fully ionized, multiple species, rotating, magnetized plasma in a vacuum-arc plasma centrifuge

is described in detail. The analysis is based on a multiple species fluid model which includes electromagnetic, pressure gradient, centrifugal and collisional forces, for each species, in cylindrical geometry. It is shown that there is a family of theoretically possible dynamical equilibrium configurations, which can be achieved by different combinations of ion rotation velocity, radial ion density distribution and radial dependence of internal electric potential. The parametric dependences of the various plasma parameters under equilibrium conditions, including the ion separation factor, are presented for a nickel-copper plasma. The numerical results are analysed and discussed on light of experimentally measured plasma characteristics in a vacuum-arc plasma centrifuge.

12925 **(ISL-R—07/85) Stationary, one-dimensional models for laser-produced plasmas.** Daree, K. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). Jun 1985. 134p. (In German). (ETN—86-97623). NTIS, PC A07/MF A01.

One-dimensional, stationary models for laser-produced plasmas were compared. The most interesting models seem to be those with the assumption of a self regulation of the plasma, i.e., based on the defined geometrical dimensions of the plasma. Such a model was numerically evaluated for a parallel flow, whereby the physical effects partial ionization, laser light absorption, and heat conduction were taken into account. The effect of several parameters (e.g., laser beam intensity, laser wavelength) on the calculation results is discussed. The calculation results agree very satisfactorily with experimental results.

12926 **(ITEF—33-1985) Some problems of data interpretation of time-of-flight mass spectrometry of laser plasma.** Latyshev, S.V.; Rudskoj, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700356.

Expansion of laser plasma in vacuum is theoretically investigated. A new assessment of the value of recombination heating bringing about quantitative agreement of the theoretical model with results of time-of-flight mass-spectrometry of laser plasma is suggested. 23 refs.; 3 figs.

12927 **(ITF—85-52-R) Nonlinear electromagnetic wave interaction in a plasma-molecular medium bounded by a spherical surface.** Zagorodnij, A.G.; Nazarenko, L.A.; Shevchenko, A.Yu.; Yakimenko, I.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1985. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87700361.

Nonlinear effects, when plane waves falling on a plasma-molecular medium bounded by a spherical surface, are investigated in the approximation of the given current. General relations for nonlinear electromagnetic field sources are presented. The solution of an electrodynamic problem of plasma-molecular sphere excitation by point dipole placed in the external region is given. Electromagnetic fields, generating due to nonlinear interaction of two plane waves, are calculated by means of the above solution and on the base of a reciprocity theorem. Numerical analysis of energy characteristics of such fields is performed, and total peculiarities of their angular and frequency distributions are established on its base. 22 refs.; 6 figs.

12928 **(KFTI—85-10) On the peculiarities of SHF radiation absorption under the electron-cyclotron method of creation of stationary plasma in stellarator Saturn.** Vasil'ev, M.P.; Kulaga, A.E.; Kuleshov, I.E.; Perepelkin, N.F.; Vojtsenya, V.S.; Voloshko, A.Yu.; Solodovchenko, S.I.; Shtan', A.F. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR); AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700354.

Peculiarities of absorption of low-power 3-centimeter wave during stationary SHF plasma heating are studied in the triple toroidal stellarator, called "Saturn". Presence of the cyclotron absorption zone into the volume of closed magnetic surfaces creates nonsymmetrical radial distributions of plasma parameters and fluxes of accelerated particles in the torr plane on both from the zone. In the cyclotron zone 1-2 mm wide electron temperature is 5-6 times higher than its mean value in the remaining filament part. The density gradient is directed out the torr, where density is twice higher than that incide the torr in front of the cyclotron zone. Intensive SHF noises in plasma at cyclotron frequencies, which spectrum wiedening was determined by toroidal magnetic field inhomogeneity, were excited behind the zone in the region of the weak field 5-6 mm wide. Intensive ion plasma noises are discovered in the ECR zone and in its vicinity. Two-temperature form of the function of energy particle distribution and oscillation spectra in plasma permit to assume the turbulent plasma SHF-heating in the resonance zone due to parametric instability development. Heavy instability of noises excited in plasma may be indicative of a relaxation character of the process of SHF pumping wave absorption in the ECR zone. 13 refs.; 27 figs.

12929 **(LRP—304/86) Finite elements applied to plasma waves.** Appert, K.; Succi, S.; Vaclavik, J.; Villard, L. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Sep 1986. 31p. (CONF-8609213—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900205.

From 1. advanced summer school on finite elements in physics; Lausanne, Switzerland (1 Sep 1986).

An introduction is given into two subjects of the theory of plasma waves and their numerical treatment with the finite element method: Linear propagation in an inhomogeneous medium and quasilinear theory. It is attempted to present the two subjects in such a way that the knowledge of plasma physics is not a prerequisite. With the information contained here a non-specialist should be able to appreciate at least the numerical part of the specialized research papers devoted to the subjects.

12930 **(ORNL/TM—9494) An experimental determination of the hot electron ring geometry in a Bumpy Torus and its implications for Bumpy Torus stability.** Hillis, D.L.; Wilgen, J.B.; Bigelow, T.S.; Jaeger, E/F.; Swain, D.W.; Hankins, O.E.; Juhala, R.E. (Oak Ridge National Lab., TN (USA)). Oct 1986. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87004048.

The hot electron rings of the ELMO Bumpy Torus (EBT) [Plasma Physics and Controlled Nuclear Fusion (IAEA, Vienna, 1975), Vol. II, p. 141] are formed by electron cyclotron resonance heating (ECRH) and have an electron temperature of 350 to 500 keV. The original intention of these hot electron rings was to provide a local minimum in the magnetic field and, thereby, stabilize the simple interchange and flute modes, which are inherent in a closed field line bumpy torus. To evaluate the electron energy density of the EBT rings and determine if enough stored energy is present to provide a local minimum in the magnetic field, a detailed understanding of the spatial distribution of the rings is imperative. The purpose of this report is to measure the ring thickness and investigate its implications for bumpy torus stability. The spatial location and radial profile of the hot electron ring are measured with a unique metal ball pellet injector, which injects small metallic balls into the EBT ring plasma. From these measurements the radial extent (or ring thickness) is about 5 to 7 cm full width at half maximum for typical EBT operation, which is much larger than previously expected. These measurements and recent modeling of the EBT plasma indicate that the hot electron ring's stored energy may not be sufficient to produce a local minimum in the magnetic field.

12931 **(PPPL—2401) Theory of current-drive in plasmas.** Fisch, N.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1986. 154p. NTIS, PC A08/MF A01. File Number DE87004047.

The continuous operation of a tokamak fusion reactor requires, among other things, a means of providing continuous toroidal current. Such operation is preferred to the conventional pulsed operation, where the plasma current is induced by a time-varying magnetic field. A variety of methods has been proposed to provide continuous current, including methods which utilize particle beams or radio frequency waves in any of several frequency regimes. Cur-

rents as large as half a mega-amp have now been produced in the laboratory by such means, and experimentation in these techniques has now involved major tokamak facilities worldwide.

12932 **(UCRL—95790) Kinetic theory of the interdiffusion coefficient in dense plasmas.** Boercker, D.B. (Lawrence Livermore National Lab., CA (USA)). Aug 1986. Contract W-7405-ENG-48. 12p. (CONF-860864—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003439.

From Meeting on strongly coupled plasma physics; Santa Cruz, CA, USA (4 Aug 1986).

Naive applications of Spitzer's theory to very dense plasmas can lead to negative diffusion coefficients. The interdiffusion coefficients in Binary Ionic Mixtures (two species of point ions in a uniform neutralizing background) have been calculated recently using molecular dynamics techniques. These calculations can provide useful benchmarks for theoretical evaluations of the diffusion coefficient in dense plasma mixtures. This paper gives a brief description of a kinetic theoretic approximation to the diffusion coefficient which generalizes Spitzer to high density and is in excellent agreement with the computer simulations. 15 refs., 1 fig., 2 tabs.

12933 **VUV study of impurity generation during ICRF heating experiments on the Alcator C tokamak.** Manning, H.L. Jr. Cambridge, MA; Harvard Univ. (1986). 223p. University Microfilms Order No. 86-20,506.

Thesis (Ph. D.).

A 2.2 m grazing incidence VUV monochromator was converted into a time resolving spectrograph by the addition of a new detector system, based on a microchannel plate image intensifier linked to a 1024-element linear photodiode array. The system covers the wavelength range 15 to 1200 A (typically 40 A at a time) with resolution of up to 0.3 A FWHM. Time resolution is selectable down to 0.5 msec. The system sensitivity was absolutely calibrated below 150 A by a soft X-ray calibration facility. The spectrograph was installed on the Alcator C tokamak at MIT to monitor plasma impurity emission. There, cross-calibration with a calibrated EUV monochromator was performed above 400 A. Calibration results, system performance characteristics, and data from Alcator C are presented. Observations of impurity behavior are presented from a series of ICRF heating experiments (180 MHz, 50-400 kW) performed on the Alcator C tokamak, using graphite limiters and stainless steel antenna Faraday shields. Large increases in metal impurity levels were seen during the RF pulse, with iron increasing by a factor of 12 at the highest RF powers. Much similar increases in carbon and oxygen were seen. Potential impurity sources and release mechanisms are discussed.

12934 **Numerical studies on the sustainment of the axial magnetic field in a reversed field pinch using a square cross section.** Odeh, I.M. Lafayette, IN; Purdue Univ. (1986). 229p. University Microfilms Order No. 86-22,201.

Thesis (Ph. D.).

A computational study of the three dimensional nonlinear resistive MHD equations for a straight cylinder is presented. The studies are applied to self-production of the an axial magnetic field, the so-called alpha effect in the reversed field pinch. The resistive MHD equations are solved by potentials that allow the resistive MHD equations are solved by potentials that allow the poloidal and toroidal symmetry of the magnetic and velocity fields to be exploited. The MHD steady state is allowed to change on a resistive time scale and solved numerically. This state is independent on z and allows the introduction of a flux function as an independent variable. The resistive MHD equations are Fourier analyzed along the ignorable coordinate of the equilibrium. Two different codes are developed. The first code is for an incompressible plasma with a specific mode number along the z axis as an approximation. Finite difference methods are employed on the x and y variables. For the incompressible case, the calculation is carried out for two spatial variations of the resistivity. The first spatial variation of the resistivity is uniform, while the second case is characterized by a sharp increase towards the wall. The second code is for three dimensional compressible MHD of constant resistivity. The simulation of the incompressible case of variable resistivity shows the production of the alpha effect, while the constant resistivity case shows the absence of the alpha effect. The simulation of the three dimensional case shows the production of the axial field.

12935 **Gyrotron: an application of the relativistic bunching of electrons to the generation of intense millimeter microwave radiation.** Caplan, M. Los Angeles, CA; Univ. of California (1986). 342p. University Microfilms Order No. 86-21,035.

Thesis (Ph. D.).

The cyclotron maser or gyrotron is capable of generating high power microwaves at millimeter wave frequencies for applications in fusion heating, radar astronomy and communications. Analytic and numerical simulation models are developed that describe the behavior of these devices under realistic laboratory conditions including the effects of circuit geometry, beam thermal spread, and mode competition. In Chapter 2, a generalized linear theory for the gyrotron is presented in the form of an integro-differential equation that can be solved within various circuit geometries thus describing gyro-amplifiers, gyro-oscillatory and gyroklystrons. In Chapter 3 a complete description of a finite size electromagnetic particle simulation model is presented that describes gyrotrons operating in a TE/sub mn/ waveguide mode. In Chapter 4 simulations and theoretical analysis are made of gyrotron amplifiers operating in the TE/sub 01/ mode. In Chapter 5 the linear eigenmodes and eigenfrequencies of gyrotron oscillators are examined. In Chapter 6 the experimental development of a GHz gyrotron is presented. Theoretical and numerical predictions of oscillation thresholds and efficiencies compare favorably with experimental data.

12936 **Alpha particle density and energy distributions in tandem mirrors using Monte-Carlo techniques.** Kerns, J.A. Troy, NY; Rensselaer Polytechnic Institute (1986). 221p. University Microfilms Order No. 86-19,986.

Thesis (Ph. D.).

Alpha particles, born at 3.52 MeV, are used to maintain the ignition temperatures in a deuterium-tritium (D-T) reacting plasma above 10 keV in tandem mirror reactors. The alpha energy is transferred to the plasma by Coulomb collisions and, after thermalization, the alphas can accumulate in the plasma and quench the reaction. The author simulated the alpha thermalization process using a Monte Carlo technique in which the alpha guiding center is followed between simulated collisions, and Spitzer's collision model is used for the alpha-plasma interaction. Monte-Carlo techniques are used to determine the alpha radial birth position, the alpha particle position at a collision, and the angle scatter and dispersion at a collision. The plasma is modeled as a hot reacting core, surrounded by a cold halo plasma ($T \sim 50$ eV). Alpha orbits that intersect the halo loose 90% of their energy to the halo electrons because of the halo drag, which is ten times greater than the drag in the core. The uneven drag across the alpha orbit also produces an outward, radial, guiding center drift. This drag drift is dependent on the plasma density and temperature radial profiles. The author modeled these profiles and have specifically studied a single-scale-length model.

12937 **Linear and nonlinear response of ion acoustic waves driven by optical mixing.** Pawley, C.J. Los Angeles, CA; Univ. of California (1986). 235p. University Microfilms Order No. 86-21,120.

Thesis (Ph. D.).

Growth and saturation of ion acoustic waves driven by two 3.3 GHz microwave pumps via optical mixing is examined both theoretically and experimentally. Two computer models are developed from the relations established through solving the Maxwell-Vlasov equations and are compared with experimental data. The models were extended to include inverse Bremsstrahlung absorption, generation of ion acoustic wave harmonics, formation of a hot ion tail distribution, and change of action potential (depletion of the highest frequency pump). Saturation of the ion acoustic wave is experimentally demonstrated and the major saturation mechanism is found to be the formation of a hot ion tail distribution. The first experimental evidence of pump depletion in an optical mixing experiment is shown, which becomes an important saturation mechanism for higher density plasmas (greater than one fourth of the critical density). These results are then compared to stimulated Brillouin scattering experiments.

12938 **Submillimeter wave propagation in tokamak plasmas.** Ma, C.H.; Hutchinson, D.P.; Staats, P.A.; Vander Sluis, K.L.; Mansfield, D.K.; Park, H.; Johnson, L.C. (Oak Ridge National Lab., TN). *Space Solar Power Review;* 6: No. 3, 221-224(1986). Contract AC05-84OR21400.

From 1985 International symposium on antennas and propagation (ISAP'85); Kyoto, Japan (20-22 Aug 1985).

Propagation of submillimeter waves (smm) in tokamak plasma was investigated both theoretically and experimentally to ensure successful measurements of electron density and plasma current distributions in tokamak devices. Theoretical analyses were carried out to study the polarization of the smm waves in TFTR and ISX-B tokamaks. A multichord smm wave interferometer/polarimeter system was employed to simultaneously measure the line electron density and poloidal field-induced Faraday rotation in the ISX-B tokamak. The experimental study on TFTR is under way. Computer codes were developed and have been used to study the wave propagation and to reconstruct the distributions of plasma current and density from the measured data. The results are compared with other measurements. 5 references, 2 figures.

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REFER ALSO TO CITATION(S) 11638, 11999, 12168

12939 **(AAEC/E—629) Variation of neutron yield from a titanium-tritide target during deuterium beam bombardment.** Dalton, A.W.; Woodley, H.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87700362.

In the laboratory simulation of D-T fusion breeder blankets, 14 MeV neutrons are produced by the bombardment of a titanium-tritide target with deuterium ions, using accelerating voltages up to 500 keV and beam currents ranging from micro to milliamperes. For the accurate determination of tritium breeding ratios in the experimental assemblies, an absolute determination of the total neutron yield over the irradiation period is required. The theoretical and experimental methods used to determine the ion composition of the deuterium beam, the changing absolute yields, and energy distributions of the neutrons emitted from the target during prolonged irradiation are described, using the AAEC 14 MeV neutron generator as a typical example. Analysis of the measured data identified two ion species in the beam of the neutron generator. It was shown that after a 21-hour irradiation of the target with a 250 μA beam (18.5C) at 200 kV, the neutron output from the D-T reaction dropped from an initial value of 2×10^{10} to 4×10^{8} neutrons per second. The integrated neutron output over this period was estimated to be 2.05×10^{14}, of which about 24 per cent originated from the interaction of monatomic ions and 75 per cent from diatomic ions; less than one per cent arose from D-D reaction.

12940 **(AD-A—172612/4/XAB) Use of incoherence to produce smooth and controllable irradiation profiles with KrF fusion lasers. Memorandum report.** Lehmberg, R.H.; Goldhar, J. (Naval Research Lab., Washington, DC (USA)). 14 Aug 1986. 21p. (NRL-MR—5829). NTIS, PC A02/MF A01.

A technique called Echelon Free Induced Spatial Incoherence, is proposed for producing smooth, controllable target beam profiles with large KrF fusion lasers. The idea is basically an image-projection technique that projects the desired time-averaged spatial profile F(x) onto the target via the laser system, using partially-coherent broadband light. The information needed to reproduce F(x) is transported through the system by a multitude of independent coherence zones, whose diameters are small in comparison to scale length of linear aberration and gain nonuniformities; as a result, F(x) remains relatively insensitive to these effects. This concept is closely related to the Induced Spatial Incoherence (ISI) technique used with glass lasers, except that it does not require echelons at the output of the system. An analysis is carried out to evaluate the perturbations of F(x) due to linear aberration, self-focusing, gain saturation, and diffraction. It shows that under conditions applicable to large KrF lasers, the perturbations will result in a small broadening and smoothing of F(x), whose functional form should be controllable to within a few percent. The ability of this technique to generate smooth focal profiles is demonstrated using a small KrF discharge oscillator preamplifier system.

12941 **(AD-A—172649/6/XAB) Control of ion-velocity distributions in laser-target interaction experiments. Memorandum report.** Grun, J.; Stellingwerf, R.; Ripin, B.H. (Mission Research Corp., Albuquerque, NM (USA)). 6 Oct 1986. 20p. NTIS, PC A02/MF A01.

The width of ion velocity distributions from laser-produced plasmas can be controlled experimentally by varying the size of the laser spot. The ion velocity width is determined primarily by whether the ions are mostly in the rarefraction or steady-state regime. It is not dominated by the thermal distribution of the ions, as is often assumed.

12942 **(AD-A—172945/8/XAB) Application of laser saturation to the efficient generation of short-wavelength radiation from plasmas. Final report, 1 November 1984-31 October 1985.** Measures, R.M. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). May 1986. 136p. NTIS, PC A07/MF A01.

Resonant laser pumping of transitions within atoms or ions represents a powerful mode of coupling laser energy into a gas or plasma. In the case of laser saturation of a resonance transition, rapid heating of the free electrons by superelastic collision quenching of the laser-pumped state has been shown to play the central role in this process. The author developed a computer code that models this laser ionization based on resonance saturation (LIBORS) and permits mapping the three-dimensional nature of this complex interaction. He was able to show, by comparison with experiment, that this LIBORS computer code can predict the radial and axial electron density and temperature profiles of the plasma formed along the path of the laser pulse. These experimental results in themselves represent the first detailed measurements of a sodium plasma created by laser resonance saturation and reveal the importance of laser attenuation in the formation of the plasma. We have also shown that both one and two photon resonant laser pumping of a cold, unexcited plasma created by two photon ionization of strontium vapor can lead to rapid excitation of high lying states of the strontium ion. Lastly, we have demonstrated parametric generation within this same strontium plasma when the laser is tuned close to a two-photon transition of the ion.

12943 (BNL—52006, pp 137-140) **Predominance of the bronze-processed compound superconductors.** Tanaka, H. (Furukawa Electric Co., Ltd., Tokyo, Japan). 1986. NTIS, PC A15/MF A01. File Number DE87001456. (CONF-860583—).

From International Committee for Future Accelerators workshop on superconducting magnets and cryogenics; Upton, NY, USA (12 May 1986).

Various processes of the superconducting compound materials are reviewed in view of their probability in large scale manufacture. Recent improvements in superconducting properties and problems in the applications of the compound conductors for magnets are also discussed. It appears that the bronze-processed Nb_3Sn and V_3Ga to be in a prominent position in practical compound superconductors.

12944 **(CONF-860917—12-Vugraphs) The compact ignition tokamak: an overview.** Flanagan, C.A. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001686.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Viewgraphs of CIT design efforts are given. (MOW)

12945 **(CONF-861019—17) Pumping of hydrocarbons using non-evaporable getters.** Emerson, L.C.; Knize, R.J.; Cecchi, J.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1986. Contract AC02-76CH03073;AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87002181.

From 10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society; Baltimore, MD, USA (27 Oct 1986).

Pumping speed measurements have been obtained for a number of gaseous hydrocarbons including members of the alkene, alkadiene, and cycloalkane groups as a function of temperature using a Zr-Al alloy getter. Pumping speeds were obtained by analysis of an exponential least squares fit to the pressure decay curve following introduction of each gas. It was found that these pumping speeds are relatively high (up to 400 l/s) and exhibit, with only a few exceptions, little temperature dependence. This is in contrast to the earlier reported results for the alkane series.

12946 (CONF-861196—1) High-throughput continuous cryopump. Foster, C.A. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.). 1986. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87000396.

From 28. annual meeting of the American Vacuum Society; Baltimore, MD, USA (3 Nov 1986).

A cryopump with a unique method of regeneration which allows continuous operation at high throughput has been constructed and tested. Deuterium was pumped continuously at a throughput of 30 Torr.L/s at a speed of 2000 L/s and a compression ratio of 200. Argon was pumped at a throughput of 60 Torr.L/s at a speed of 1275 L/s. To produce continuous operation of the pump, a method of regeneration that does not thermally cycle the pump is employed. A small chamber (the "snail") passes over the pumping surface and removes the frost from it either by mechanical action with a scraper or by local heating. The material removed is topologically in a secondary vacuum system with low conductance into the primary vacuum; thus, the exhaust can be pumped at pressures up to an effective compression ratio determined by the ratio of the pumping speed to the leakage conductance of the snail. The pump, which is all-metal-sealed and dry and which regenerates every 60 s, would be an ideal system for pumping tritium. Potential fusion applications are for mpmp limiters, for repeating pneumatic pellet injection lines, and for the centrifuge pellet injector spin tank, all of which will require pumping tritium at high throughput. Industrial applications requiring ultraclean pumping of corrosive gases at high throughput, such as the reactive ion etch semiconductor process, may also be feasible.

12947 (DOE/ER/52111—1-10/86) Application of railgun principle to high-velocity hydrogen pellet injection for magnetic fusion reactor refueling: Technical progress report. Kim, K. (Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering). 10 Nov 1986. Contract FG02-84ER52111. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87003417.

A detailed experimental study successfully demonstrates the acceleration of frozen hydrogen pellets by means of a fuseless two-stage electromagnetic railgun system. This system consists of a pneumatic hydrogen pellet injector, which freezes and pneumatically pre-accelerates (with high-pressure helium as the propellant gas) cylindrical 1.6-mm-dia by 2.15-mm-long hydrogen pellets, and a 60-cm-long, 1.6-mm-dia circular-bore electromagnetic railgun. The pellet is introduced into the railgun by means of a coupling piece, and a plasma-arc armature is created from the propellant gas by means of a very unique, fuseless, arc-initiation scheme. Railgun-accelerated hydrogen pellet velocities in excess of 1.6 km/s are achieved from pneumatically accelerated injection velocities of 800 m/s. Streak-camera and current-probe data show that the plasma-arc armature moves at a velocity proportional to the railgun current, I. Insight to this I-dependence is gained through the use of streak photography and current probes for varying bore geometries and gas pressures.

12948 (DOE/ER/53198—102) Reversed field pinch boundary study: Quarterly progress report for the period Sept. 13, 1986-Dec. 13, 1986. Dexter, R.N.; Prager, S.C.; Sprott, J.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). Jan 1987. Contract FG02-85ER53198. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003998.

This report summarizes our progress during the seventh quarter of support of our RFP boundary study. We began and successfully completed the installation of the optimized divertor rings, thereby initiating Subproject-2. Plasmas have been formed and studied at the 100 kA level, but reversal as not yet been achieved. A program of glow and pulsed discharge cleaning has been initiated. We also took occupancy of a newly created control room adjacent to the eventual placement of MST. Optical cabling for the new data acquisition system was installed, and we are now using MDS, the MIT-developed Model Data (acquisition) System. Our engineers inspected the fabrication status and quality of MST in Italy, and reviewed the remaining scheduling features.

12949 (DOE/ER/53227—98) Stochasticity about a poloidal divertor separatrix. Skinner, D.A.; Osborne, T.H.; Prager, S.C.; Park, W. (Wisconsin Univ., Madison (USA). Dept. of Physics). Oct 1986. Contract FG02-86ER53227. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003388.

The stochasticization of the magnetic separatrix due to the presence of a helical perturbation in a poloidal divertor tokamak is illustrated by a numerical computation which traces magnetic field lines.

12950 (DOE/ER/53227—101) Equilibrium studies of a poloidal divertor pinch with a reversed-toroidal field. Sarff, J.S.; Sprott, J.C.; Turner, L. (Wisconsin Univ., Madison (USA). Dept. of Physics). Nov 1986. Contract FG02-86ER53227. 38p. NTIS, PC A03. File Number DE87004143.

An analytic solution for the force-free magnetic field, del x B-vector = λB-vector, in the poloidal divertor configuration of the Tokapole II device is presented. Experiments conducted on Tokapole II which provide equilibrium magnetic field profile measurements using a magnetic probe are then described. Observations include a non-constant-λ profile and a large diamagnetic current near the magnetic separatrix.

12951 (GA-A—18133) Program element 2: Blanket and shield thermal-hydraulic and thermomechanical testing of the first Wall/Blanket/Shield program: Final report. (GA Technologies, Inc., San Diego, CA (USA)). Nov 1986. Contract W-31-109-ENG-38. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87004042.

Two single-effect scoping tests were performed in Phase 1 of this project. These tests included the measurement of heat transfer contact resistance between a Li_2O breeder pellet and stainless steel clad in argon gas - in the temperature range of 500° to 700°C. The effective heat transfer coefficient was found to lie in the range of 1100 to 1700 W/m²-K which is acceptable for the design of Li_2O solid breeder blankets. This effective heat transfer coefficient is expected to improve in helium gas, which has a much higher thermal conductivity than argon. In the second set of tests, the thermomechanical behavior of Li_2O pellets was determined under simulated blanket conditions, including thermal cycling, in the presence of a helium gas purge flow of controlled moisture content. The results showed that at a temperature below 800°C and with a reasonable purge flow moisture content of ≈10 ppM, Li_2O pellet sintering and pore closure, pellet-clad interaction and vapor phase transport of LiOH are minimal. A multiple-effects solid breeder blanket integral simulation test, followed by an engineering-scale nuclear test are the proposed next steps in this series of tests. Preliminary designs for these experiments were completed. Fabrication techniques for the manufacturing of microspheres as an alternate fuel form for solid breeder fuel were also investigated in the study. Microspheres of $LiAlO_2$ from <30 μm to 180 μm were fabricated by the plasma spray technique. Production of $\sim$650 μm spheres by a sol-gel process was demonstrated and feasibility was indicated from the production of spheres from $\sim$100 μm to $\sim$800 μm in diameter.

12952 (IAE—4106/15) Data control system for the T-15 installation. Balabanov, Yu.V.; Matalin-Slutskij, L.A.; Timonin, V.V.; Fyakhretdinov, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700364.

A conception model of the automatization system of a physical experiment at the T-15 tokamak is described. Architecture of a

data control system and characteristics of a data base control system, suggested for application, are discussed. 11 refs.; 13 figs.; 1 tab.

12953 (INIS-SU—364, pp 219-226) **Problems of power, efficiency and frequency increasing for gyrotrons used in plasma investigations.** Gol'denberg, A.L.; Zapevalov, V.E.; Malygin, S.A. 1984. (In Russian). NTIS (US Sales Only), PC A16/MF A01. File Number DE87780019. (CONF-8406342—Vol.1).

From 3. All-Union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (20 Jan 1984).

Ways of increasing efficiency of gyrotrons used for electron-cyclotron heating of plasma are studied. A possibility of magnetic field reduction during operation at harmonics of gyrofrequency as well as a possibility of using pulsed solenoids with long-term HF-pulse duration (0.1 s) are disclosed. It is also shown that two-stage recuperation of residual energy of electron flux permits to increase gyrotron efficiency up to 90%.

12954 (LBL—22296) **Heavy-ion fusion accelerator research, 1985.** (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003541.

A plan for exploring the physics and technology of induction linac development is discussed which involves a series of increasingly sophisticated experiments. The first is the single-beam transport experiment, which has explored the physics of a single space-charge-dominated beam. Second is the multiple-beam experiment in which four independent beams will be transported and accelerated through a multigap accelerating structure. The single-beam transport experiment is described, and some results are given of stability studies and instrumentation studies. The design and fabrication of the multi-beam experiment are described, as well as results of a first round of experiments in which beam-current amplification was observed. Concurrent theoretical work, resulting in a variety of acce-leration schedules and sets of associated voltage waveforms required to implement the experiments, is also reported. (LEW)

12955 (NIIEFA-P-B—0698) **Analysis of magnetic and electrostatic field penetration through the blanket of a tokamak reactor on the discharge start.** Astapkovich, A.M.; Sadakov, S.N. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87700363.

The technique of transient electromagnetic processes analysis in azimuthal-sectional constructions, using the coupled circuit approach, is considered. Calculational results of a vertical magnetic field and a vortex electromotive force (e.m.f.) penetration through the blanket of a tokamak reactor at the beginning of the discharge start are presented. The dependence of penetration delay in the magnetic field and vortex e.m.f. on the value of active blanket resistance in tracing the torus is obtained. 6 refs.; 6 figs.

12956 (UCID—20863) **TIBER II: Tokamak Ignition/Burn Experimental Reactor: 1986 status report.** Henning, C.D.; Logan, B.G. (Lawrence Livermore National Lab., CA (USA)). 23 Oct 1986. Contract W-7405-ENG-48. 255p. NTIS, PC A12/MF A01; GPO Dep. File Number DE87003975.

Several chapters are presented that cover the following areas: (1) physics basis; (2) current drive; (3) compact divertors; (4) neutron shielding; (5) high-current density, radiation-tolerant magnets; and (6) costs. (MOW)

12957 (UCRL—15623-85) **Development of charcoal sorbents for helium cryopumping.** Sedgley, D.W.; Tobin, A.G. (Grumman Aerospace Corp., Bethpage, NY (USA); Lawrence Livermore National Lab., CA (USA)). 30 Sep 1985. Contract W-7405-ENG-48. 41p. (AES—85-90). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003889.

Improved methods for cryopumping helium were developed for application to fusion reactors where high helium generation rates are expected. This study period evaluated charcoal particle size, bonding agent type and thickness, and substrate thickness. The optimum combination of charcoal, bond, and substrate was used to form a scaled-up panel for evaluation in the Tritium Systems Test Assembly (TSTA) at Los Alamos. The optimum combination is a 12 x 30 mesh coconut charcoal attached to a 0.48 cm thick copper substrate by a 0.015 cm thick silver phosphorus copper braze. A copper cement bond for attaching charcoal to a substrate was identified and tested. Helium pumping performance of this combination was comparable to that of the charcoal braze system. Environmental tests showed the charcoal's susceptibility to vacuum chamber contamination. Performance degradation followed exposure of ambient temperature charcoal to a vacuum for prolonged periods. Maintaining a liquid nitrogen-cooled shield between the charcoal and the source of contamination prevented this degradation. A combination of bake-out and LN shielding effected recovery of degraded performance.

12958 (UCRL—53723) **Static and dynamic analyses on the MFTF [Mirror Fusion Test Facility]-B Axicell Vacuum Vessel System: Final report.** Ng, D.S. (Lawrence Livermore National Lab., CA (USA)). Sep 1986. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87003972.

The Mirror Fusion Test Facility (MFTF-B) at Lawrence Livermore National Laboratory (LLNL) is a large-scale, tandem-mirror-fusion experiment. MFTF-B comprises many highly interconnected systems, including a magnet array and a vacuum vessel. The vessel, which houses the magnet array, is supported by reinforced concrete piers and steel frames resting on an array of foundations and surrounded by a 7-ft-thick concrete shielding vault. The Pittsburgh-Des Moines (PDM) Corporation, which was awarded the contract to design and construct the vessel, carried out fixed-base static and dynamic analyses of a finite-element model of the axicell vessel and magnet systems, including the simulation of various loading conditions and three postulated earthquake excitations. Meanwhile, LLNL monitored PDM's analyses with modeling studies of its own, and independently evaluated the structural responses of the vessel in order to define design criteria for the interface members and other project equipment. The assumptions underlying the finite-element model and the behavior of the axicell vessel are described in detail in this report, with particular emphasis placed on comparing the LLNL and PDM studies and on analyzing the fixed-base behavior with the soil-structure interaction, which occurs between the vessel and the massive concrete vault wall during a postulated seismic event. The structural members that proved sensitive to the soil effect are also reevaluated.

12959 (UCRL—93786) **Compact Torus plasma ring accelerator: a new type driver for inertial confinement fusion.** Hartman, C.W.; Eddleman, J.L.; Hammer, J.H.; Meeker, D.L. (Lawrence Livermore National Lab., CA (USA)). 22 Aug 1986. Contract W-7405-ENG-48. 5p. (CONF-860601—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE86016081.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

We discuss the acceleration of magnetically-confined plasma rings to provide a driver for ICF. The acceleration of plasma rings is predicted to be efficient and following focusing, to generate ion-bombardment power in the range 10^{15} to 10^{16} W/cm^2 at a total deposition energy of multimegajoules. The simplicity of plasma ring accelerator suggests that a 5 MJ (on target) driver would cost in the range 1 to 5 $/joule. First experimental tests of the accelerator are described.

12960 (UCRL—94217) **Construction and operation of the 12-T superconducting coils for the Mirror Fusion Test Facility.** Zbasnik, J.P.; Kozman, T.A.; Shimer, D.W.; Hathaway, D.R. (Lawrence Livermore National Lab., CA (USA)). 25 Sep 1986. Contract W-7405-ENG-48. 7p. (CONF-860914—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003394.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

We have successfully constructed and tested a pair of high-field coils that is part of the magnet set of the Mirror Fusion Test

Facility (MFTF-B) at the Lawrence Livermore National Laboratory. Each coil consists of a multifilamentary Nb_3Sn magnet nested inside a multifilamentary NbTi magnet. During our test, these coils produced a central field of 12 T, with a peak conductor field of 12.5 T. The dimensions of the Nb_3Sn insert coil are: 1.34-m bore, 2.57-m outer diameter, and 1.14-m overall length. These coils were designed to be fully cryogenically stabilized and cooled by pool-boiling liquid helium. The operating current density of the Nb_3Sn coils is 2000 A/cm^2 and 2400 A/cm^2 for the NbTi magnet. In this paper, we present design considerations and details, construction techniques, and operational results of these coils.

12961 **(UCRL—94382) Review of target studies for heavy ion fusion.** Lindl, J.D.; Bangerter, R.D.; Mark, J.W.K.; Pan, Y.L. (Lawrence Livermore National Lab., CA (USA)). 24 Oct 1986. Contract W-7405-ENG-48. 12p. (CONF-860510—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003257.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We present an updated set of gain curves for radiation driven ion beam targets. The improved target performance calculated with nuclear spin polarized fuel will also be discussed. We discuss the conditions required for efficient conversion to x-rays of ion beam energy. These requirements are compared with those obtained for lasers. Recent results on symmetry requirements for direct drive ion beam targets are presented.

12962 **(UCRL—94638) Targets for laser and ion beam drivers.** Bangerter, R.O. (Lawrence Livermore National Lab., CA (USA)). 24 Oct 1986. Contract W-7405-ENG-48. 8p. (CONF-860510—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87003256.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

At the two previous heavy ion fusion symposia, researchers from Livermore presented their best estimates of target energy gain. The results presented at Tokyo differed significantly from those presented at Darmstadt. The Livermore estimates were again revised for this symposium. The new estimates are given in an accompanying paper by Lindl et al. and in additional detail in this paper. The new estimates are similar to the results presented at Darmstadt. The implications of the new results are discussed.

12963 **Variable control of neutron albedo in toroidal fusion devices.** Jassby, D.L.; Micklich, B.J. (to Dept. of Energy, Washington, DC). US Patent 4,626,400. 2 Dec 1986. Filed date 1 Jun 1983. v.p.

This patent describes a toroidal fusion plasma device, including a vacuum vessel for confining a plasma which contains fusion neutrons. The vacuum vessel has inboard and outboard walls, a arrangement for varying, between steady state operating modes, one of the flux and the energy spectrum of the fusion neutrons which are incident on the outboard wall. The arrangement comprises: neutron reflective material exclusively disposed immediately adjacent the inboard wall so as to reflect ones of the fusion neutrons having a predetermined flux and energy spectrum onto a predetermined portion of the outboard wall; and means for positioning the neutron reflective material into and out of communication with the fusion neutrons, whereby at least one of the flux and the energy spectrum of the fusion neutrons which are incident on the outboard wall is varied when the albedo material is in communication with the fusion neutrons.

12964 **Limiter.** Cohen, S.A.; Hosea, J.C.; Timberlake, J.R. (to Dept. of Energy, Washington, DC). US Patent 4,626,399. 2 Dec 1986. Filed date 19 Oct 1984. v.p.

This patent describes a nuclear fusion vacuum vessel having an inner wall; a scrape-off region which includes a bulk plasma energetic ions, and slide away electrons; and an improved limited, cylindrically symmetrical about an axis and rotatable about the axis. The limiter has a front face and a back face, the front face having an annular flat portion covering a major portion of the front face, and indented portion and a vertex therebetween. The vertex forms a leading edge for the slide away electrons, whereby the heat load absorbed by the limiter is distributed thereon upon rotation thereof.

12965 **Prospects for developing attractive magnetic fusion concepts.** Dean, S.O.; Clarke, J.F.; Fowler, T.K.; Furth, H.P.; Kulcinski, G.L.; Nuckolls, J.H.; Sheffield, J. (Fusion Power Assoc., Gaithersburg, MD). *Journal of Fusion Energy;* 5: No. 2, 107-122(Jun 1986). (CONF-850157—).

From Fusion Power Associates symposium on the search for attractive fusion concepts; La Jolla, CA, USA (31 Jan 1985).

Prospects are discussed for accelerating the fusion reactor program, specifically that engineers must show a systematic progress along the path to fusion power, that there must be a clear indication that they are intending to develop a commercial product, and that there must be in this country, a level of total R & D on energy technology that is commensurate with the energy problem that faces the United States in the future. Certain laboratory studies are cited. Selected areas of magentic fusion reactor improvement in the last decade, and the characteristics of attractive fusion reactors are discussed. Reactor design and fusion program costs are also examined.

12966 **Lasers and particle beam for fusion and strategic defense.** *Journal of Fusion Energy;* 5: No. 1, 95(Mar 1986). (CONF-850476—).

From Symposium on lasers and particle beams for fusion and strategic defense; Rochester, NY, USA (18 Apr 1985).

This special issue of the Journal of Fusion Energy consists of the edited transscripts of a symposium on the applications of laser and particle beams to fusion and strategic defense. Its eleven papers discuss these topics: the Strategic Defense Initiative; accelerators for heavy ion fusion; rf accelerators for fusion and strategic defense; Pulsed power, ICF, and the Strategic Defense Initiative; chemical lasers; the feasibility of KrF lasers for fusion; the damage resistance of coated optic; liquid crystal devices for laser systems; fusion neutral-particle beam research and its contribution to the Star Wars program; and induction linacs and free electron laser amplifiers for ICF devices and directed-energy weapons.

12967 **Determination of thermal conductivity from specific heat and thermal diffusivity measurements of plasma-sprayed cermets.** Roth, E.P.; Smith, M.F. (Sandia National Labs, Alboquerque, NM). *International Journal of Thermophysics;* 7: No. 2, 455-466(Mar 1986). (CONF-850617—).

From 9. symposium on thermophysical properties; Boulder, CO, USA (24 Jun 1985).

The thermal conductivities of three plasma-sprayed cermets have been determined over the temperature range 23-630 degrees C from the measurement of the specific heat, thermal diffusivity, and density. These cermets are mixtures of Al and SiC prepared by plasma spray deposition and are being considered for various applications in magnetic confinement fusion devices. The samples consisted of three compositions: 61 vol% Al/39 vol% SiC, 74 vol% Al/26 vol% SiC, and 83 vol% Al/17 vol% SiC. The specific heat was determined by differential scanning calorimetry through the Al melt transition up to 720°C, while the thermal diffusivity was determined using the laser flash technique up to 630°C. The linear thermal expansion was measured and used to correct the diffusivity and density values. The thermal diffusivity showed a significant increase after thermal cycling due to a reduction in the intergrain contact resistance, increasing from 0.4 to 0.6 cm /SUP 2./ S^{-1} at 160°C. However, effective medium theory calculations indicated that the thermal conductivities of both the Al and the SiC were below the ideal defect-free limit even after high-temperature cycling. The specific heat measurements showed suppressed melting points in the plasmasprayed cermets. The 39 vol% SiC began a melt endotherm at 577°C, which peaked in the 640-650°C range depending on the sample thermal history. Chemical and X-ray diffraction analysis indicated the presence of free silicon in the cermet and in the SiC powder, which resulted in a eutectic Al/Si alloy.

12968 **Conceptual design and neutronics analyses of a fusion reactor blanket simulation facility.** Beller, D.E. Lafayette, IN; Purdue Univ. (1986). 140p. University Microfilms Order No. 86-22,116.

Thesis (Ph. D.).

A new conceptual design of a fusion reactor blanket simulation facility was developed. This design follows the principles that have been successfully employed in the Purdue Fast Breeder Blan-

ket Facility (FBBR), because experiments conducted in it have resulted in the discovery of deficiencies in neutronics prediction methods. With this design, discrepancies between calculation and experimental data can be fully attributed to calculation methods because design deficiencies that could affect results are insignificant. Inelastic scattering cross sections are identified as a major source of these discrepancies. The conceptual design of this FBBR analog, the fusion reactor blanket facility (FRBF), is presented. Essential features are a cylindrical geometry and a distributed, cosine-shaped line source of 14-MeV neutrons. This source can be created by sweeping a deuteron beam over an elongated titanium-tritide target. To demonstrate that the design of the FRBF will not contribute significant deviations in experimental results, neutronics analyses were performed: results of comparisons of 2-dimensional to 1-dimensional predictions are reported for two blanket compositions. Expected deviations from 1-D predictions which are due to source anisotropy and blanket asymmetry are minimal. Thus, design of the FRBF allows simple and straightforward interpretation of the experimental results, without a need for coarse 3-D calculations.

99 GENERAL AND MISCELLANEOUS

12969 **(K/CSD/INF—86/19P) Using bar code technology to enhance classified document accountability.** Mountain, P.J.; Wade, D.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1986. Contract AC05-84OT21400. 28p. (CONF-8611101—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87000760.

From 14. annual conference of the Department of Energy/ contractors micrographics and Information Management Association; Pleasanton, CA, USA (4 Nov 1986).

This paper describes a system of resources and procedures coordinated to improve a classified document inventorying process. The Bar Code Document Accountability System (BARDAS) was developed to demonstrate the feasibility of improving the management and reporting timeliness of secret document inventories by the accountable custodians. The paper discusses the reasons for the development method, the extensive error-checking, the degree of user-friendliness, and the use of bar code technology in accomplishing these goals. Finally, the reactions of users to the system and future plans for enhancement are discussed.

12970 **(LA—10899-SR) The Los Alamos National Laboratory (USA): Instituto Mexicano del Petroleo cooperative program for the ASPEN flowsheet simulator: Status report.** Phillips, T.T. (Los Alamos National Lab., NM (USA)). Jan 1987. 50p. NTIS, PC A03/MF A01. File Number DE87003806.

On June 20, 1983, the Los Alamos National Laboratory, the US Department of Energy, and the Instituto Mexicano del Petroleo (IMP) signed a Memorandum of Understanding (MOU) that established a program of cooperation between the Los Alamos National Laboratory and the IMP. This report describes the work done under Annex II of the MOU, which set up a program in the area of process simulation using the ASPEN flowsheet simulator. As a part of this program, two IMP engineers were trained at Los Alamos: one as an ASPEN system administrator and the other as an ASPEN applications engineer. After returning to Mexico, these engineers installed ASPEN on the IMP VAX computer and trained 30 other IMP engineers and scientists to use ASPEN. To date, IMP used ASPEN to simulate four major process plants. In addition, engineers from Los Alamos and IMP worked together during the summer of 1986 to develop an implementation of the UNIFAC method for predicting liquid-phase activity coefficients. The code was written and installed in ASPEN and has passed a series of initial test cases. The UNIFAC model will be released to the public domain when testing is complete. IMP has also developed and shared with Los Alamos some enhancements to a computer code that predicts physical property correlation constants for petroleum fractions. The success of the Los Alamos/IMP cooperative program for the ASPEN flowsheet simulator demonstrates that technology transfer can work in both directions. 18 refs.

12971 **(LA-UR—86-2600) Los Alamos science, Number 14.** (Los Alamos National Lab., NM (USA)). Fal 1986. Contract W-7405-ENG-36. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87003612.

Nine authored articles are included covering: natural heat engine, photoconductivity, the Caribbean Basin, energy in Central America, peat, geothermal energy, and the MANIAC computer. Separate abstracts were prepared for the articles. (DLC)

12972 **(LBL-PUB—445-6/86) Recent papers submitted and reports issued.** (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 20p. NTIS, PC A02/ MF A01; GPO Dep. File Number DE87000180.

A total of 168 papers and reports are listed under: accelerator and fusion research, applied science, biology and medicine, Center for Advanced Materials, chemical biodynamics, computing, earth sciences, engineering, materials and molecular research, nuclear science, and physics. (DLC)

9901 Management

12973 **(AD-A—172402/0/XAB) Slam simulation base escape model using response surface methodology. Master's thesis.** Clark, S.P. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 111p. (AFIT/GST/OS—86M-3). NTIS, PC A06/MF A01.

This thesis presents a microcomputer-compatible, base escape nuclear-survivability model specifically designed to compute SAC alert aircraft pre-launch survivability. It computes the number of aircraft surviving from single or multiple bases under Sea Launched Ballistic Missile (SLBM) attack. The FORTRAN model concentrates on simulating the process from alert to take-off. In particular, it models the statistical variability of crew reaction time, engine start time, taxi time, and take-off separation time under various levels of readiness. Nuclear overpressure, gust, and thermal fluences are determined through response surface methods, and aircraft survivability is derived from cumulative log-normal damage functions. Its advantages over current base escape models are microcomputer compatibility and stochastic representation of the pre-launch survivability timing variables.

12974 **(AD-A—172419/4/XAB) Methodology for comparing a standoff weapon with current conventional munitions in a runway attack scenario. Master's thesis.** Coulter, D.M.; Fry, D.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1986. 190p. (AFIT/GST/OS—86M-4). NTIS, PC A09/MF A01.

This research developed a SLAM discrete-event simulation model to support a methodology for comparing a standoff weapon with current conventional weapons. This study is limited to the defensive threats within a 20-NM terminal area surrounding a generic Warsaw Pact airfield. The emphasis of the study was simulation of the standoff weapon interactions with the terminal threats. Previous models have not attempted to model the threat reactions to the standoff-weapons. The resulting simulation enables the analyst to study the effects of weapon release conditions on weapon attrition, runway damage effectiveness, and aircraft attrition.

12975 **(DOE/MA—0276) Department of Energy audit liaison, followup and internal control review activity: Quarterly management report as of September 30, 1986.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Audit Liaison Div.). Dec 1986. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003698.

There were 56 audit reports received with $2.6 million in new questioned costs. There were 54 reports closed, and the amounts reinstated and recovered were $2.2 million and $0.9 million, respectively. Four draft reports and one final GAO report requiring responses to GAO and/or the Congress were received and an additional 46 final reports were received for information. Seventeen inspector general (IG) reports were issued requiring preparation of a Departmental position. As of September 30, 1986, a total

of 133 internal control reviews (ICRs) were in the Departmental Internal Control Tracking System (DICTS) inventory.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 10821, 10891, 11172, 11936, 12882, 12883

12976 (AD-A—172196/8/XAB) RAMBOT (Restructuring Associative Memory Based on Training): a connectionist expert system that learns by example. Technical report, October 1985-April 1986. Mozer, M.C. (California Univ., San Diego, La Jolla (USA). Inst. for Cognitive Science). Aug 1986. 31p. (ICS—8610). NTIS, PC A03/MF A01.

Expert systems seem to be quite the rage in artificial intelligence, but getting expert knowledge into these systems is a difficult problem. One solution would be to endow the systems with powerful learning procedures that could discover appropriate behaviors by observing an expert in action. A promising source of such learning procedures can be found in recent work on connectionist networks, that is, massively parallel networks of simple processing elements. This paper discusses a connectionist expert system that learns to play a simple video game by observing a human player. The game, Robots, is played on a two-dimensional board containing the player and a number of computer-controlled robots. The object of the game is for the player to move around the board in a manner that will force all of the robots to collide with one another before any robot is able to catch the player. The connectionist system learns to associate observed situations on the board with observed moves. It is capable not only of the human player, but of learning generalizations that apply to novel situations.

12977 (AD-A—173122/3/XAB) Parallel unification scheduling in Prolog. Technical report. Citrin. (California Univ., Berkeley (USA)). 18 Sep 1986. 68p. NTIS, PC A04/MF A01.

Unification, the fundamental operation in the Prolog logic programming language can take up to 50% of the execution time of a typical Prolog system. One approach to speeding up the unification operation is to perform it on parallel hardware. Although it has been shown that, in general, there is no parallel algorithm for unification that is better than the best sequential algorithm, there is a substantial subset of unification which may be done in parallel. Identifying these subsets involves gathering data using an extension of Chang's static data-dependency analysis (SDDA), then using that data to schedule the components of a unification for parallel unification. Improvements to the information gathered by SDDA may be achieved through procedures splitting, a source-level transformation of the program. This thesis describes and evaluates the abovementioned techniques and their implementation. Results are compared to other techniques for speeding up unification. Ways in which these techniques may be applied to the Berkeley PLM machine are also described.

12978 (AD-A—173271/8/XAB) Block-oriented, local-memory-based linear-equation solution on the CRAY-2. Calahan, D.A. (Michigan Univ., Ann Arbor (USA). Dept. of Electrical Engineering and Computer Science). Aug 1986. 5p. NTIS, PC A02/MF A01.

The performances of a number of algorithms for the solution of (dense) linear equations are presented for the CRAY-2. Measurements show as much as a 6:1 speedup of blocked algorithms over conventional vectorized Gauss elimination. Execution rates in the range of 400 MFLOPS are achieved.

12979 (AD-A—173283/3/XAB) Applying activation theory for modeling task interference in dual-task situations. Final report, March 1985-June 1986. Navon. (California Univ., San Diego, La Jolla (USA). Inst. for Cognitive Science). 14 Jun 1986. 14p. NTIS, PC A02/MF A01.

The purpose of this one-year contract was to attempt to model the sources of task interference other than competition for processing resources. First, a general theory of attention was developed. The theory posits parallel computations by entities called modules, with little competition for common resources. Attention is assumed to control only the communication among modules. It is shown that the attentional mechanism is a vehicle for achieving selectivity, but is less fit for coping with multiple goals. Second, task interference of a type that is called crosstalk was computer-simulated on a parallel distributed processing network. Several interesting results emerge out of the simulation. Third, the role of conflict between outcomes of processes in producing task interference was studied experimentally. Subjects searched for different sorts of targets, each assigned to a different attentional channel. Confusability between channels and congruence of responses to them were found to be potent determinants of task interference. The author suggest that potential sources of outcome conflict may contribute to dual-task interference and argue that a great deal of the residual interference might result from other sorts of outcome conflict.

12980 (AD-A—173501/8/XAB) Visibility or disability: notes on attention. Technical report, July 1985-May 1986. Navon. (California Univ., San Diego, La Jolla (USA). Inst. for Cognitive Science). Jun 1986. 29p. (ICS—8606). NTIS, PC A03/MF A01.

This paper describes the framework of a theory of attention that posits parallel computations with little competition for common resources. The mind is likened to a set of processing entities called modules that may be active in parallel. Their activation is externally driven. Cooperation among modules lis often required for achieving goals which in turn calls for communication. Attention is assumed to control only the communication among modules. It exerts attentional emphasis by bringing the output of a to-be-attended module to the information of a maximal number of other modules, while limiting the ability of deemphasized modules to disseminate their output. This is achieved by a mechanism called decoupling that controls the connections among modules. The control of decoupling that is required for attentional emphasis is associated with an aversive phenomenal aspect that is usually called effort. The decoupling mechanism is a vehicle for achieving selectivity. It is less fit for coping with multiple goals. The reason is that confusion and outcome conflict are likely when more than one goal is emphasized. The architecture of the control over decoupling and the strategies used to cope with various situations are elaborated on.

12981 (AD-A—173593/5/XAB) Implementation of a multi-lingual database system - multi-backend database system interface. Master's thesis. Holste, S.T. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1986. 128p. NTIS, PC A07/MF A01.

The limitations of the traditional Database Management System(DBMS) have become increasingly clear in recent years. Some of these limitations are interface inflexibility for user accesses, mono-lingual restriction in data languages, performance degradations over time, and excessive costs in upgrading. Two complementary approaches to the DBMS design and implementation--the multilingual database system(MLDS) and the multi-backend database system(MBDS)--effectively deal with the limitations of the traditional DBMS approach. MLDS offers a multi-lingual capability to the DBMS environment, thus freeing the user from the limitations and inflexibility of the single-data-model-and-language approach. MBDS, by contrast, is designed to deal with the issues of performance degradation and upgrading costs by providing a parallel-processing capability, and utilizing replicated software and identical hardware for expansion. System upgrades with BDS have been shown to provide an essentially proportional performance gain-to-upgrade-cost ratio. This thesis presents the implementation of an interface between MLDS and MBDS. Specifically, the author presents the procedures which create the template and Descriptor files in MLDS that are required by MBDS. Additionally the integration process tying these two systems together are described.

12982 (ANL—86-47) Mathematics and Computer Science Division Five-Year Plan, 1986-1991. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004148.

This report sets forth the plans for the Mathematics and Computer Science Division during the next five years. These plans build on the Division's strong research programs in applied analy-

sis, computational mathematics, software methodology, and advanced computing. The report addresses five major issues: research programs, research environment, dissemination of research techniques, initiatives, and resource projections. Throughout, we summarize past and current efforts, and propose new areas of research and application. We view this report as a dynamic document that will be updated and revised as the Division continues its investigations in the forefront of mathematics and computer science.

12983 (ANL/MCS-TM—85) Solving banded systems on a parallel processor. Dongarra, J.J.; Johnsson, L. (Argonne National Lab., IL (USA)). Nov 1986. Contract W-31-109-ENG-38. 44p. NTIS, PC A03/MF A01. File Number DE87004032.

Ways of solving dense, banded systems on different parallel processors are examined. Processors with vector instructions are considered, and then various algorithms for the solution of large, dense, banded systems on a parallel processor are discussed. The behavior of the parallel algorithms on distributed-storage architectures configured as rings, two dimensional meshes with end-around connections (tori), boolean n-cube configured architectures, and bus-based and switch-based machines with shared storage is discussed. Measurements are presented for two bus-based architectures with shared storage, namely, the Alliant FX/8 and the Sequent Balance 21000. 43 refs.

12984 (CONF-870239—1) Observability analysis and bad data processing for state estimation using Hachtel augmented matrix method. Wu, F.F.; Liu, W.H.E.; Holten, L.; Gjelsvik, A.; Aam, S. (California Univ., Berkeley (USA); Norwegian State Power Board, Oslo; Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway)). 1987. Contract AC01-84CE76257. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001320.

From 15. power industry computer application conference; Montreal, Canada (1 Feb 1987).

The triangular-factorization-based observability analysis and the normalized-residual-based bad data processing are extended to state estimation using Hachtel augmented matrix method. The Hachtel method is numerically robust, computationally efficient, and reasonable in extra storage requirement. In this paper it is shown that the observability analysis can be carried out in the process of triangular factorization of the augmented coefficient matrix used in the Hachtel method. Moreover, the normalized residuals are shown to be obtainable using the sparse inverse of this augmented matrix. The algorithms have been successfully incorporated in the state estimation program developed at Norwegian State Power Board (Statkraft). Test results on the IEEE 14 bus system and a 99-bus system consisting of the main grid of Southern Norway are presented. The Hachtel approach to state estimation provides an attractive alternative to the standard normal equations approach. 30 refs., 4 figs., 2 tabs.

12985 (CONF-8607100—1) Neural network modeling of early retinal vision processes. Jorgensen, C.C. (Oak Ridge National Lab., TN (USA). Engineering Physics and Mathematics Div.). 1986. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87000746.

From NEUROCON 1 conference; San Jose, CA, USA (27 Jul 1986).

This paper considers two techniques to obtain values for parameters in models of vision processes in early layers of the human retina. The work is part of a long-term effort to develop a robot vision system using three computational principles of neural networks. These principles are: massive parallelism, dynamic feedback, and multi-layer pattern recognition. Two network models were studied. The first represented lateral inhibition processes as a matrix of two-dimensional linear equations with limited feedback. The second represented multi-layer networks as matrices of dynamic, two-dimensional nonlinear differential equations. The lateral inhibition model was parameterized using psychophysical data from human judgments of pattern brightness in a machband illusion. A 2-D Fourier transform was made of original and perceived patterns and used to solve for the coefficient matrix of the neural network. The coefficients were then applied to the pixel matrix of a Herman grid illusion and compared with the corresponding human subjective results through three-dimensional plots of pixel intensities. The second model was analyzed using a new computer simulation developed to work with moving images and adjustable neural connection topologies. 19 refs., 8 figs.

12986 (CONF-8609173—5) Studies of random number generators for parallel processing. Bowman, K.O.; Robinson, M.T. (Oak Ridge National Lab., TN (USA)). Sep 1986. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002817.

From 2. conference on hypercube multiprocessors; Knoxville, TN, USA (29 Sep 1986).

If Monte Carlo calculations are to be performed in a parallel processing environment, a method of generating appropriate sequences of pseudorandom numbers for each process must be available. Frederickson et al. proposed an elegant algorithm based on the concept of pseudorandom or Lehmer trees: the sequence of numbers from a linear congruential generator is divided into disjoint subsequences by the members of an auxilary sequence. One subsequence can be assigned to each process. Extensive tests show the algorithm to suffer from correlations between the parallel subsequences: this is a result of the small number of bits which particpate in the auxiliary sequence and illustrates the well-known discovery of Marsaglia. Two alternative algorithms are proposed, both of which appear to be free of interprocess correlations. One relaxes the conditions on the Lehmer tree by using an arbitrary auxiliary multiplier: it is not known to what extent the subsequences are disjoint. The other partitions the main sequence into disjoint subsequences by sending one member to each process in turn, minimizing interprocess communication by defining new sequence generating parameters. 10 refs., 4 figs.

12987 (DOE/ER/25009—327) Load balancing and sparse matrix vector multiplication on the hypercube. Fox, G.C. (California Inst. of Tech., Pasadena (USA)). 22 Jul 1986. Contract FG03-85ER25009. 35p. (CALT—68-1406). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003563.

We consider the calculation on a hypercube concurrent computer, of matrix vector multiplication $y = Ax$ where A is a large sparse matrix. A good decomposition is crucial for the case when each column of A on the average has fewer non zero elements than there are nodes in the hypercube. We develop graph theoretical and simulated annealing techniques which can lead to essentially optimal hypercube decompositions. The performance of the concurrent computer depends strongly on any correlations in the placement of non zero elements of A. 7 refs., 8 figs., 2 tabs.

12988 (DOE/ER/25009—336) Iterative full matrix-vector multiplication on the hypercube. Fox, G.C. (California Inst. of Tech., Pasadena (USA)). 29 Jul 1986. Contract FG03-85ER25009. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003561.

We analyze the performance of the hypercube for the iterative matrix vector multiplication y = ...A/sub j/A/sub j-1/ ...$A_3A_1A_0x$ in the case where the matrix A is full and quite small. 2 refs., 4 figs.

12989 (DOE/ER/25009—356) A comparison of the performance of the Caltech Mark 2 hypercube and the Elxsi 6400. Walker, D.W.; Fox, G.C.; Ho, A.; Montry, G.R. (California Inst. of Tech., Pasadena (USA); Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract FG03-85ER25009. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003559.

Previous work has investigated the use of the pre-conditioned, conjugate gradient (pcg) algorithm in solving finite element problems on the multi-processor Elxsi 6400, and has shown how the optimal use of cached and shared memory can result in faster code. In this paper the implementation of the algorithm on both the Caltech hypercube and the Elxsi 6400 are discussed. It was found that on both machines the pcg part of the code runs with efficiency greater than 90% for all problems large enough to be of interest. Sequential code can be ported to a shared memory machine without making algorithmic changes, however, extra coding is required to ensure cache coherency. When porting code to a hypercube it is often necessary to make algorithmic changes. A good implementa-

tion of the code discussed here on a shared memory machine would use a hypercube type of algorithm, with software support for hypercube message passing. 11 refs., 6 figs., 5 tabs.

12990 (K/CSD/TM—64) Automated Estimating System (AES): User's manual. Brandon, M.D.; Holder, D.A. Schwarz, R.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1986. Contract AC05-84OT21400. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87004231.

This document describes Version 1.3 of the Automated Estimating System, a personal computer-based software package designed to aid in the creation, updating, and reporting of project cost estimates for the Estimating and Scheduling Department of the Martin Marietta Energy Systems Engineering Division.

12991 (LA—10898-MS) Los Alamos National Laboratory computer benchmarking, 1986. Simmons, M.L.; Wasserman, H.J. (Los Alamos National Lab., NM (USA)). Jan 1987. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003805.

This report summarizes the results of computer performance evaluations as measured by the Computer Research and Applications Group of the Los Alamos National Laboratory. The benchmarks were conducted between September 1983 and November 1986. Important characteristics of the machines tested are given, and execution times or megaflop rates for a set of portable Fortran 77 benchmark codes are listed. A brief description of the codes is included. Tests were performed on the following computers: Cray Research Inc. (CRI) CRAY-1S, X-MP/24, X-MP/48, X-MP/216, X-MP/416, and CRAY-2; Control Data Corporation (CDC) CYBER 825, 855, and 205; Fujitsu VP-200; Hitachi S810/20; NEC SX-2; IBM 3090/200; Digital Equipment Corporation (DEC) VAX 11/780, 11/785, and 8600; and the Convex Computer Corporation C-1. 12 refs., 10 tabs.

12992 (LA-UR—86-3628) Dimension density: An intensive measure of chaos in spatially extended turbulent systems. Kurz, T.; Mayer-Kress, G. (Los Alamos National Lab., NM (USA)). May 1986. Contract W-7405-ENG-36. 5p. (CONF-8605145—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87001976.

From International conference on the physics of phase space; College Park, MD, USA (20 May 1986).

The determination of correlation dimensions by the Grassberger-Procaccia algorithm from an experimental time series has become a standard tool in the analysis of low dimensional chaotic systems. Here we want to carry over this method to spatially extended systems which have a decaying spatial correlation. In these cases the total number of degrees of freedom or overall "dimension" grows with the size of the system. Then in a finite size system the dimension of the overall dynamics can be recovered already from a single point measurement, if the resolution is greater than some size dependent threshold. Therefore we expect that the measured dimension values will increase when smaller and smaller spatial structures are resolved. This feature is also observed in turbulence experiments [U. Frisch]. Thus the objective is to get an intensive (i.e. size independent) measure which locally characterizes turbulent systems. 5 refs., 2 figs.

12993 (LBL-PUB—3061) SUSIE reference manual. Belshe, R.A. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003553.

SUSIE is a program for interactive analysis of one and two dimensional spectra. It runs on the Modcomp Classic computers, and uses the Tektronix 4014 with a high-speed DMA interface and a LBL designed supplemental control panel. The original Modcomp version was written by M. Neiman (LBL PUB-3014, Feb. 1981). The current version is the result of a number of major revisions and extensions, the most significant being the addition of 2-D spectra, and the ability to access spectra which are created by the EVA event sorting program.

12994 (N—86-33032) First 3 years of operation of RIACS (Research Institute for Advanced Computer Science) (1983-1985). Final Report. Denning, P.J. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Apr 1986. 8p. (NASA-CR—179699; NAS—1.26:179699). NTIS, PC A02/MF A01.

The focus of the Research Institute for Advanced Computer Science (RIACS) is to explore matches between advanced computing architectures and the processes of scientific research. An architecture evaluation of the MIT static dataflow machine, specification of a graphical language for expressing distributed computations, and specification of an expert system for aiding in grid generation for two-dimensional flow problems was initiated. Research projects for 1984 and 1985 are summarized.

12995 (N—87-11511) Parallel processors and nonlinear structural dynamics algorithms and software. Final Technical report, 1 March-30 October 1986. Belytschko, T. (Northwestern Univ., Evanston, IL (USA)). Nov 1986. 35p. (NASA-CR—179889; NAS—1.26:179889). NTIS, PC A03/MF A01.

A nonlinear structural dynamics program with an element library that exploits parallel processing is under development. The aim is to exploit scheduling-allocation so that parallel processing and vectorization can effectively be treated in a general purpose program. As a byproduct an automatic scheme for assigning time steps was devised. A rudimentary form of the program is complete and has been tested; it shows substantial advantage can be taken of parallelism. In addition, a stability proof for the subcycling algorithm has been developed.

12996 (NUREG/CR—4591) INGEN: A COBRA-NC input generator user's manual. Wheeler, C.L.; Dodge, R.E. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of BWR Licensing). Dec 1986. Contract AC06-76RL01830. 155p. (PNL—5827). NTIS, PC A08/MF A01 - GPO. File Number TI87003862.

The INGEN (INput GENerator) computer program has been developed as a preprocessor to simplify input generation for the COBRA-NC computer program. INGEN uses several empirical correlations and geometric assumptions to simplify the data input requirements for the COBRA-NC computer code. The simplified input scheme is obtained at the expense of much flexibility provided by COBRA-NC. For more complex problems requiring additional flexibility however, INGEN may be used to provide a skeletal input file to which the more detailed input may be added. This report describes the input requirements for INGEN and describes the algorithms and correlations used to generate the COBRA-NC input. 9 refs., 3 figs., 6 tabs.

12997 (ORNL—6261, pp 166-171) **Heuristic modeling.** May 1986. NTIS, PC A10/MF A01. File Number DE86011391.

In Chemistry Division annual progress report for period ending January 31, 1986.

In the teaching profession, the adjective "heuristic" designates an educational method by which a pupil is stimulated to make his or her own investigations and discoveries. The term heuristic modeling as applied to computational chemistry denotes the application of programming techniques, often from the field of artificial intelligence, to problems in chemistry which are not sufficiently well understood to permit rigorous mathematical modeling and first principle calculations. The diverse areas described below - printing ink formulation, machine inspection of printed currency, photographic color reproduction, and the synthesis of organic molecules - require heuristic modeling with a combination of nonnumerical and numerical programming methods. 18 refs., 1 fig.

12998 (ORNL/TM—10172) Advanced distributed processing with focus and PC/focus: Planning considerations and phased implementation. Snyder, C.E.; Hanlon, D.R. Jr.; Bettis, L.J.; O'Malley, J. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87004030.

A distributed data system that included shared data resident in a mainframe/PC local area network environment was successfully introduced to nontechnical end-users. The system provided the end-user with the control of responsiveness and reliability inherent in local application processing, along with the back-up support and archival storage/retrieval provided by a mainframe computer. A semaphore-driven locking scheme ensured referential data integrity across the shared data system, and HASP protocols provided fast and reliable file transfer capability. The project demonstrates that distributed methods can be applied to information systems to increase their efficiency and productivity. When the resources are on hand for such a system, planning and a phased approach to the appropriate implementation can bring success even in an end-user environment. 11 refs., 2 figs.

12999 **(REPT—5-46) Note on waiting times in systems with queues in parallel.** Blanc, J.P.C. (Technische Hogeschool Delft (Netherlands)). 1985. 13p. (ETN—86-98476). NTIS, PC A02/MF A01.

Numerical data concerning the mean and variance of the waiting time distribution for systems with queues in parallel, in which customers choose the shortest queue upon arrival are presented. A numerical method for calculating state probabilities and moments of queue length distributions is outlined. The method is based on power series expansions and recursion. It is applicable to systems with more than one waiting line. Numerical data concerning the mean and variance of the waiting time distribution for systems with queues in parallel, in which customers choose the shortest queue upon arrival are presented. A numerical method for calculating state probabilities and moments of queue length distributions is outlined. The method is based on power series expansions and recursion. It is applicable to systems with more than one waiting line.

13000 **(SAND—86-0586C) Interpretive model for "A Concurrency Method".** Carter, C.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 27p. (CONF-870208—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE86012655.

From 6. annual IEEE Phoenix conference on computers and communications; Scottsdale, AZ, USA (25 Feb 1987).

This paper describes an interpreter for "A Concurrency Method," in which concurrency is the inherent mode of operation and not an appendage to sequentiality. This method is based on the notions of data-drive and single-assignment while preserving a natural manner of programming. The interpreter is designed for and implemented on a network of Corvus Concept Personal Workstations, which are based on the Motorola MC68000 super-microcomputer. The interpreter utilizes the MC68000 processors in each workstation by communicating across OMNINET, the local area network designed for the workstations. The interpreter is a complete system, containing an editor, a compiler, an operating system with load balancer, and a communication facility. The system includes the basic arithmetic and trigonometric primitive operations for mathematical computations as well as the ability to construct more complex operations from these. 9 refs., 5 figs.

13001 **(SAND—86-0827) Data compression techniques for use with the SITAN [Sandia Terrain-Aided Navigation] algorithm.** Fellerhoff, J.R.; Creel, E.E. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1987. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01; 2; GPO Dep. File Number DE87003782.

Data compression algorithms are becoming an important part of systems that use digital terrain elevation data (DTED) such as moving map display systems, terrain-following and terrain-avoidance systems, and terrain-aided navigation systems. This paper describes and compares two DTED compression techniques for use with the Sandia Terrain-Aided Navigation (SITAN) algorithm designed specifically for operation in a land vehicle. One technique uses the two-dimensional discrete cosine transformation (2-D DCT) combined with linear scaling; the other uses data decimation in the spatial domain, followed by a differential pulse code modulation operation on the decimated spatial data. These techniques are designed to minimize the DTED reconstruction error for a given compression ratio and are targeted for implementation in the Motorola 68000-based Sandia Aerospace Computer. This paper presents a description of the DTED and its use by the SITAN algorithm. Also, background information concerning the 2-D DCT is presented, followed by a description of the two data compression algorithms. Experimental results are presented which show the magnitude of reconstruction errors for various sets of DTED and various compression ratios. Finally, the effect of reconstruction errors on SITAN performance is presented. 11 refs., 35 figs., 2 tabs.

13002 **(SAND—86-2633) HSTART: An improved initial step size routine for ODE codes.** Watts, H.A. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1986. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87003965.

For the solution of initial value ordinary differential equations by library quality solvers, such as the DEPAC collection in the SLATEC library, it is important to start off with a good initial step size in order for the procedure to produce a reliable and efficient solution numerically. A substantial improvement has been made in the starting step size algorithm which corrects a long standing deficiency. Specifically, initial step sizes many orders from optimal (arising from stiff problems with mixed zero and nonzero initial values of disparate sizes) are brought under control.

13003 **(SLAC-PUB—3894) SLACnet: Implementation and experiences.** Cottrell, R.L.A.; Downey, T.; Frese, H.; Granieri, C.; Huffer, M.; Moss, L.; Streater, T.; Saxton, O.; Wiser, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1986. Contract AC03-76SF00515. 22p. (CONF-8603169—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003275.

From SHARE '66; Anaheim, CA, USA (16 Mar 1986).

SLACnet is a Local Area Network (LAN) using Ethernet and the Xerox Network System (XNS) protocols. It currently provides datagram, virtual circuit, remote procedure call and file transfer services. SLACnet connects together mutiple DEC VAX computers running VMS and an IBM 3081K mainframe running VM/SP. The IBM 3081 is connected to the Ethernet via a Device Attachment Control Unit (DACU). The source code consists of about 25K lines of C and 8K lines of assembler. About 16K lines are common to the IBM VM/SP and the DEC VMS implementations. SLACnet has been in production 24 hours a day since April, 1985, and coexists with DECnet on the same Ethernet. SLACnet is designed to keep the impact on the IBM 3081 to a minimum, and provide easy to use conversion between VM/SP and VMS sequential files. SLACnet provides bulk transport of up to a Gbyte/day of physics data between the VAXes and the IBM 3081, as well as the transfer of program source files, listings, object code, etc. This talk describes how SLACnet fits into VM, the services provided, the mapping between the DEC and IBM worlds, the performance of the various layers, the impact on VM/SP, and the development effort involved. 31 refs., 5 figs., 3 tabs.

13004 **(UCID—20896) BLOCKER: A block diagram editing utility, release notes.** Anderson, R. (Lawrence Livermore National Lab., CA (USA)). 9 Oct 1986. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003886.

The BLOCKER block diagram utility was written in the interest of promoting better software documentation. It allows the user to easily create block diagrams which can be stored within software source text files and printed out with standard line printing devices. In this way, sketches which are often drawn on paper during software coding can be kept in an organized manner for later reference. BLOCKER is written in the PRAXIS programming language; it runs on VT-100-compatible terminals under version 4.3 of the VMS operating system on VAX computers. 9 refs.

13005 **(UCID—20928) Cooperating intelligent agents.** Mason, C. (Lawrence Livermore National Lab., CA (USA)). Dec 1986. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87003976.

Distributed Artificial Intelligence is the subfield of Artificial Intelligence concerned with the creation of intelligent problem solving systems which are based on observtions of cooperative sys-

tems in our lives. This group problem solving approach promises a number of advantages over current sequentially based problem solvers. This paper presents an overview of the research issues which concern Distributed Artificial Intelligence and focuses on the design of such systems.

13006 **(UCRL—95441) Current and future issues in the design, analysis, and implementation of Distributed Computer-based Control Systems.** Suski, G.J.; Rodd, M.G. (Lawrence Livermore National Lab., CA (USA); University Coll. of Swansea (UK)). Sep 1986. Contract W-7405-ENG-48. 21p. (CONF-8609206—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002553.

From 7. IFAC workshop on distributed computer control systems; Bonn, F.R. Germany (29 Sep 1986).

The field of distributed computer control system engineering as applied specifically to laboratory, manufacturing, and process control applications, encompasses a spectrum of diverse computer disciplines. Over the past several years, researchers and applications engineers in this area have focused their attention on a variety of issues. The issues deemed most important have varied over time according to developments in hardware and software technology, trends towards more stringent performance and reliability criteria, evolution of internationally accepted standards, and the emergence of new application areas. Successive workshops in the IFAC series on Distributed Computer Control Systems (DCCS) have provided forums for discussing these issues. Early workshops concentrated on systems architectures and relevant issues such as programming languages, open versus closed architectures, and the applicability of emerging standards. Most recently, discussions have intensified on control system issues pertaining to flexible manufacturing systems and the development of modeling techniques to allow verification of system designs. It is evident that the emphasis changes with time. It has also become apparent that the evolution of technology frequently leads to the revisiting of prior issues for which new improved solutions become available. 42 refs., 11 figs.

13007 **(UCRL—95629) Calculation of Rayleigh-Taylor flows using vortex blobs.** Kerr, R.M. (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 12p. (CONF-870235—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87002551.

From 3. international conference on stratified flows; Pasadena, CA, USA (3 Feb 1987).

A modification of a boundary-integral method is used to study the single-scale Rayleigh-Taylor instability for arbitrary Atwood number. Smoothing the Green's function using vortex blobs suppresses singularities in the curvature and other modifications are designed to extend the calculation through several singular events. The method successfully follows the development of a single mode to states with asymptotic velocities for the bubble and spike that depend on Atwood number and are independent of the blob size. Incipient droplet formation is observed. 15 refs., 6 figs.

13008 **WELDEX: An expert system for non-destructive testing of welds.** Mahalingam, S.; Sharma, D.D. (AI Knowledge Based Systems Group, Battelle Columbus Labs.). pp 572-576 of Proceedings of the 2nd conference on artificial intelligence applications. The engineering of knowledge-based systems. Piscataway, NJ; IEEE Service Center (1985). (CONF-851245—).

From 2. conference on artificial intelligence applications; Miami Beach, FL, USA (11 Dec 1985).

Expert systems are ideal for applications that require a large amount of specialized knowledge to solve problems. This paper describes an expert system, WELDEX, for identifying weld faults using the radiographic inspection technique. WELDEX is an implementation of the knowledge and reasoning process used by a human expert in interpreting the radiographs. WELDEX has been successful in interpreting standard radiographs of pipe line welds.

13009 **Learned navigation paths for a robot in unexplored terrain.** Iyengar, S.S.; Jorgensen, C.C.; Rao, S.V.N.; Weisbin, C.R. (Dept. of Computer Science, Louisiana State Univ., Baton Rouge, LA 70803). pp 148-155 of Proceedings of the 2nd conference on artificial intelligence applications. The engineering of knowledge-based systems. Piscataway, NJ; IEEE Service Center (1985). (CONF-851245—).

From 2. conference on artificial intelligence applications; Miami Beach, FL, USA (11 Dec 1985).

Finding optimal paths for robot navigation in known terrain has been studied for some time but, in many important situations, a robot would be required to navigate in completely new or partially explored terrain. The authors propose a method of robot navigation which requires no pre-learned model, makes maximal use of available information, records and synthesizes information from multiple journeys, and contains concepts of learning that allow for continuous transition from local to global path optimality. The model of the terrain consists of a spatial graph and a Voronoi diagram. Using acquired sensor data, polygonal boundaries containing perceived obstacles shrink to approximate the actual obstacles surfaces, free space for transit is correspondingly enlarged, and additional nodes and edges are recorded based on path intersections and stop points. Navigation planning is gradually accelerated with experience since improved global map information minimizes the need for further sensor data acquisition. The authors' method currently assumes obstacle locations are unchanging, navigation can be successfully conducted using two-dimensional projections, and sensor information is precise.

13010 **Self-organization of neural networks.** Clark, J.W.; Winston, J.V.; Rafelski, J. (Washington Univ., St. Louis, MO). *Physics Letters [Section] A;* **102A**: No. 4, 207-211(14 May 1984).

The plastic development of a neural-network model operating autonomously in discrete time is described by the temporal modification of interneuronal coupling strengths according to momentary neural activity. A simple algorithm (brainwashing) is found which, applied to nets with initially quasirandom connectivity, leads to model networks with properties conducive to the simulation of memory and learning phenomena. 18 references, 2 figures.

13011 **Long-range percolation in one dimension.** Spouge, J.L. (Los Alamos National Lab., NM). *Journal of Physics A: Mathematical and General;* **17**: 2349-2350(1984).

For lattice sites at integer values, the probability of a bond between sites m and n is a/absolute value of m-n/ where $a_0 = 0$. The authors strengthen Schulman's criterion for absence of an infinite cluster and suggest a Monte Carlo method for determining critical probabilities. The results derived from comparison of Schulman's Bethe lattice to branching processes. The authors note that a/sub n/ = pa/absolute value n/ (pa, $a < 1$) is probably the most mathematically tractable example of long-range percolation although it does not permit an infinite cluster. 3 references.

13012 **Harmonic analysis of a source identification problem.** Arnold, E.M. (Battelle Pacific Northwest Lab., Richland, WA). *Quarterly of Applied Mathematics;* 331-338(Oct 1982).

This paper presents the problem of identifying a source in a porous medium which hosts a steady flow field. The medium properties and the velocity potential are assumed known. The known functions will be considered as deterministic at first. The stochastic source identification problem will be considered later. A function f is sought satisfying the following equation: [div(K grad phi) = f] on a region D contained in R/sup n/ with known potential phi and permeability K. 7 references.

9903 Information Handling

REFER ALSO TO CITATION(S) 10709, 10710, 10771, 10890, 10892, 10893, 12976

13013 **(PB—86112349) Guidelines for descriptive cataloging of reports: A revision of COSATI standard for descriptive cataloging of government scientific and technical reports.** (Commerce, Energy, NASA, Defense Information (CENDI) Cataloging Committee, Washington, DC (USA)). 1985. 98p. NTIS, PC A05/MF A01. File Number TI87900459.

Revised COSATI guidelines developed to maximize standardization of descriptive cataloging entries are defined. The rules presented govern the form of the essential cataloging elements for reports processed by the major federal information processing agencies: US Department of Commerce, US Department of Energy, National Aeronautics and Space Administration, and US Department of Defense. The elements are: accession number, organization name, organization code, title (unclassified), subtitle or descriptive note, personal author, publication date, pagination (for printed documents), funding number, report number, availability, supplementary note, and security classification. Additional elements of information and retrieval such as subject fields and groups, descriptors/subject terms, and abstract are also included within the scope of this standard. The guidelines are intended to provide users with a form of citation and index entries consistent within the products of the various information systems, and to facilitate the exchange of bibliographic information among the federal information processing agencies in the technical report literature field without costly duplicative effort, especially for machine-readable media.

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Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik
Development of applicable methods for evaluating the safety of offshore structures. Pt. 1, 12:11922 (R;DK)

Acurex Corp., Mountain View, CA (USA). Environmental Systems Div.
Performance evaluation of a ceramic fabric bag filter on a bench-scale coal gasifier: Final report, 12:11180 (R;US)

Aerospace Corp., El Segundo, CA (USA). Materials Sciences Lab.
Fiber-matrix interactions in carbon-fiber/cement matrix composites. Technical report, 12:11705 (R;US)

AiResearch Mfg. Co., Torrance, CA (USA)
Advanced high-power generator research program. Final report, January 1984-October 1985, 12:11918 (R;US)

Air Force Geophysics Lab., Hanscom AFB, MA (USA)
Solar gradual hard x-ray bursts and associated phenomena, 12:12566 (R;US)
Structure of the extended emission in the infrared celestial background, 12:12562 (R;US)

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Extreme-ultraviolet beam-foil spectroscopy of highly ionized neon and argon. Doctoral thesis, 12:12583 (R;US)

Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering
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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC05-86OR21600	**Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center**	
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AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
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AC06-76RL01350	**General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation**	
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AC06-76RL01830	**Pacific Northwest Lab., Richland, WA (USA)**	
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	12:10916	PNL—6074
	12:10936	EPRI-NP—4886
	12:10951	PNL—6051
	12:10979	PNL—6047
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AC06-76RL01857	**UNC Nuclear Industries, Inc., Richland, WA (USA)**	
	12:10986	UNI-SA—183
	General Electric Co., Shippingport, PA (USA). Nuclear Energy Business Operations	
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AC06-81ER40048	**Nuclear Physics Laboratory, University of Washington, Seattle, Washington 98195**	
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AC06-84ER40124	**Washington Univ., Seattle (USA). Nuclear Physics Lab.**	
	12:12146	DOE/ER/40124—11
AC07-76ID01570	**USDOE Idaho Operations Office, Idaho Falls**	
	12:10912	EGG-M—35186
	EG and G Idaho, Inc., Idaho Falls (USA)	
	12:10929	DOE/LLW—59T
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	Idaho National Engineering Lab., Idaho Falls (USA)	
	12:12000	EGG-M—11186
AC07-84ID12519	**Battelle Columbus Labs., OH (USA)**	
	12:11555	DOE/ID/12519—T1
AC07-86ID12584	**USDOE Grand Junction Projects Office, CO. Technical Measurements Center**	
	12:10980	GJ/TMC—24
AC08-83NV10282	**EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations**	
	12:12210	EGG—10282-5022
	EG and G Energy Measurements, Inc., Las Vegas, NV (USA)	
	12:12267	EGG—10282-1110
AC08-85NV10384	**Nevada Univ., Reno (USA). Water Resources Center**	
	12:12316	DOE/NV/10384—04
AC09-76SR00001	**Bechtel National, Inc., San Francisco, CA (USA)**	
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	SRI International, Menlo Park, CA (USA)	
	12:11754	DOE/SR/00001—T120
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
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AC19-85BC10830	**Keplinger Technology Consultants, Inc., Tulsa, OK (USA)**	
	12:10852	DOE/BC/10830—4
AC21-80ET14928	**General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center**	
	12:10702	DOE/ET/14928—2233
AC21-82MC20229	**USDOE Morgantown Energy Technology Center, WV**	
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AC21-83FC10601	**Texas A and M Univ., College Station (USA). Kinetics, Catalysis, and Reaction Engineering Lab.**	
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AC21-84FC10620	**Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering**	
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AC21-84MC21099	**USDOE Morgantown Energy Technology Center, WV**	
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AC21-84MC21167	**SRI International, Menlo Park, CA (USA)**	
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AC21-84MC21175	**USDOE Morgantown Energy Technology Center, WV**	
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AC21-84MC21289	**USDOE Morgantown Energy Technology Center, WV**	
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AC21-84MC21384	**USDOE Morgantown Energy Technology Center, WV**	
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AC21-84MC21388	**Physical Sciences, Inc., Andover, MA (USA)**	
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AC21-84MC21389	**USDOE Morgantown Energy Technology Center, WV**	
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AC21-84MC21391	USDOE Morgantown Energy Technology Center, WV	
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AC21-84MC21394	USDOE Morgantown Energy Technology Center, WV	
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AC21-85FC10627	Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences	
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AC21-85LC11061	Terra Tek, Inc., Salt Lake City, UT (USA)	
	12:10894	DOE/LC/11061—T11
AC21-85MC21353	USDOE Morgantown Energy Technology Center, WV	
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	12:10710	DOE/METC—86/6050
	12:10821	DOE/METC—86/6047
	12:10822	DOE/METC—86/6048
	12:10890	DOE/METC—86/6057
	12:10891	DOE/METC—86/6058
	12:10892	DOE/METC—86/6059
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AC21-85MC22075	USDOE Morgantown Energy Technology Center, WV	
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AC21-85MC22221	Pittsburgh Univ., PA (USA)	
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AC21-85MC22224	Institute of Gas Technology, Chicago, IL (USA)	
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AC21-86MC22250	Transamerica Delaval, Inc., Trenton, NJ (USA). Biphase Energy Systems Div.	
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AC22-76ET10532	Chevron Research Co., Richmond, CA (USA)	
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AC22-82PC50041	Catalytic, Inc., Wilsonville, AL (USA)	
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AC22-83PC60015	Univ. of Wyoming, Laramie	
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AC22-84PC70512	Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center	
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AC22-84PC70815	TRW Space and Technology Group, Redondo Beach, CA (USA)	
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AC22-85PC71504	Gilbert/Commonwealth, Inc., Reading, PA (USA)	
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AC22-85PC80012	Arkansas Univ., Fayetteville (USA). Dept. of Chemical Engineering	
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AC22-85PC80013	Bechtel National, Inc., San Francisco, CA (USA)	
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AC22-85PC81008	Tennessee Univ., Tullahoma (USA). Space Inst.	
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AC22-85PC81201	Institute of Gas Technology, Chicago, IL (USA)	
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AC22-86PC91404	Viking Systems International, Pittsburgh, PA (USA)	
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AC79-84BP18186	Oregon Univ., Portland (USA). Health Sciences Center	
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AH21-85MC03193	Pittsburgh Univ., PA (USA)	
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AI01-77CS51040	Garrett Turbine Engine Co., Phoenix, AZ (USA)	
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AI01-80CS80010	Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development	
	12:11011	TVA/OACD—86/10
AI03-86SF16310	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
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AI08-76DP00474	Geological Survey, Denver, CO (USA)	
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AI79-86BP60445	Washington State Dept. of Game, Olympia (USA). Habitat Management Div.	
	12:12315	DOE/BP/60445—1
AI79-86BP61748	Public Utility District No. 1 of Chelan County, Wenatchee, WA (USA)	
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AM03-76SF00115	SRI International, Menlo Park, CA	
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AS03-80ER10637	California Univ., Irvine (USA). Dept. of Physiology and Biophysics	
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AS03-81ER40004	California Univ., Berkeley (USA)	
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AS03-83ER13125	California Institute of Technology, Pasadena	
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AS03-83ER40120	California Univ., Los Angeles (USA). Dept. of Electrical Engineering	
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AS04-85AL31881	Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering	
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AS05-76ER03956	**Tennessee Univ., Knoxville (USA). Dept. of Physics**	
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AS05-76ER04447	**Univ. of Tennessee, Knoxville**	
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AS05-76ER04449	**Texas A and M Univ., College Station (USA). Research Foundation**	
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AS05-76ER04928	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
	12:12644	DOE/ER/04928—14
AS05-76ER05126	**Maryland Univ., College Park (USA). Dept. of Physics and Astronomy**	
	12:12756	DOE/ER/05126—302
AS05-76ER05172	**Maryland Univ., College Park (USA). Dept. of Chemistry**	
	12:12702	DOE/ER/05172—0028
AS05-76ER05226	**Texas A and M Univ., College Station (USA). Dept. of Chemistry**	
	12:11809	DOE/ER/05226—4
AS05-76ET12139	**North Carolina Univ., Chapel Hill (USA). Dept. of Geology**	
	12:12534	DOE/ET/12139—T2
AS05-76EV03941	**Duke Univ., Durham, NC**	
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AS05-78ET52025	**Georgia Inst. of Tech., Atlanta (USA). Fusion Research Center**	
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AS05-83CE23858	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
	12:11517	DOE/CE/23858—T2
AS08-84DP40199	**Brigham Young Univ., Provo, UT (USA)**	
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AS09-76ER00854	**Univ. of Georgia, Athens**	
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FC03-82CE30701	**Sacramento Municipal Utility District, CA (USA)**	
	12:11060	DOE/CE/30701—T9
FC07-80CS40380	**Cornell Univ., Ithaca, NY (USA)**	
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FC07-80ID12128	**Tallahassee, City of, FL (USA)**	
	12:11017	DOE/ID/12128—1
FC07-81ID12188	**South Point Ethanol, OH (USA)**	
	12:11006	DOE/ID/12188—T2-Vol.1
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FC21-83FE60177	**Western Research Inst., Laramie, WY (USA)**	
	12:10705	DOE/FE/60177—2249
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FC22-83FE60149	**National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)**	
	12:10854	NIPER—173
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FC22-83FE60339	**Southern Illinois Univ., Carbondale (USA)**	
	12:10764	DOE/FE/60339—T42
FG01-83PE70523	**Aspen Inst. for Humanistic Studies, CO (USA)**	
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FG01-84CE15187	**Network Systems Development Associates, Jenkintown, PA (USA)**	
	12:11195	DOE/CE/15187—T8
FG01-85CE15239	**Single-Ply Inst. of America, Inc., Pasadena, MD**	
	12:11025	DOE/CE/15239—T6
FG01-85CE26520	**District Heating Development Co., St. Paul, MN (USA)**	
	12:11417	DOE/CE/26520—T1
FG02-81WM46642	**Vermont Environmental Conservation Agency, Montpelier (USA). Office of the State Geologist**	
	12:10934	DOE/WM/46642—T3
FG02-83NE44345	**Georgia Dept. of Natural Resources, Atlanta (USA)**	
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FG02-84ER13218	**Univ. of Illinois, Urbana**	
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FG02-84ER13260	**Kent State Univ., OH (USA)**	
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FG02-84ER40146	**Syracuse Univ., NY (USA). Dept. of Physics**	
	12:12697	DOE/ER/40146—T1

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FG02-84ER45106	**Connecticut Univ., Storrs (USA)**	
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FG02-84ER45112	**Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering**	
	12:11708	DOE/ER/45112—3
FG02-84ER45149	**Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Metallurgical Engineering and Materials Science**	
	12:11610	DOE/ER/45149—2
FG02-84ER45173	**Minnesota Univ., Minneapolis (USA)**	
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FG02-84ER52111	**Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering**	
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FG02-84ER53179	**Syracuse Univ., NY (USA). Dept. of Physics**	
	12:12864	DOE/ER/53179—T5
FG02-85CE40738	**Institute of Paper Chemistry, Appleton, WI (USA)**	
	12:11552	DOE/CE/40738—T2
FG02-85ER13329	**Massachusetts Univ., Amherst (USA). Dept. of Chemical Engineering**	
	12:11750	DOE/ER/13329—2
FG02-85ER13337	**Yale Univ., New Haven, CT (USA)**	
	12:12423	DOE/ER/13337—T1
FG02-85ER40213	**Arizona Univ., Tucson (USA). Dept. of Physics**	
	12:12648	DOE/ER/40213—2
FG02-85ER45179	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
	12:11612	DOE/ER/45179—T1
	Massachusetts Inst. of Tech., Cambridge (USA). Corrosion Lab.	
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FG02-85ER45183	**Purdue Univ., Lafayette, IN (USA)**	
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FG02-85ER45188	**Pennsylvania Univ., Philadelphia (USA)**	
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FG02-85ER45199	**Purdue Univ., Lafayette, IN (USA). Dept. of Physics**	
	12:12861	DOE/ER/45199—T1
FG02-85ER45200	**Missouri Univ., Columbia (USA). Research Reactor Facility**	
	12:12862	DOE/ER/45200—2-10/86
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FG02-85ER45217	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering**	
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FG02-85ER53198	**Wisconsin Univ., Madison (USA). Dept. of Physics**	
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FG02-85ER53211	**Rensselaer Polytechnic Inst., Troy, NY (USA)**	
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FG02-85ER60281	**Univ. of Rochester, NY**	
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FG02-85ER60293	**Delaware Univ., Newark (USA). Coll. of Marine Studies**	
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FG02-85ER60316	**Massachusetts Univ., Amherst (USA)**	
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FG02-86CH10255	**Texas Southern Univ., Houston (USA). Dept. of Chemistry**	
	12:12333	DOE/CH/10255—1
FG02-86CH10268	**Penobscot Indian Nation, Old Town, ME (USA)**	
	12:10928	DOE/CH/10268—1
FG02-86CH10288	**Selma Univ., AL (USA). Div. of Natural and Applied Sciences**	
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FG02-86ER13484	**Northwestern Univ., Evanston, IL (USA). Technological Inst.**	
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FG02-86ER13488	**Chicago Univ., IL (USA)**	
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FG02-86ER13495	**Cornell Univ., Ithaca, NY (USA)**	
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FG02-86ER13501	**Arizona Univ., Tucson (USA). Dept. of Chemistry**	
	12:11814	DOE/ER/13501—T1
FG02-86ER13512	**Minnesota Univ., St. Paul (USA)**	
	12:11005	DOE/ER/13512—1
FG02-86ER13516	**Missouri Univ., Columbia (USA)**	
	12:11028	DOE/ER/13516—T1
FG02-86ER13528	**Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering**	
	12:11988	DOE/ER/13528—1
FG02-86ER53223	**New York Univ., NY (USA). Courant Inst. of Mathematical Sciences**	
	12:12914	DOE/ER/53223—17
FG02-86ER53227	**Wisconsin Univ., Madison (USA). Dept. of Physics**	
	12:12915	DOE/ER/53227—99
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85-90	*See* UCRL-15623-85	E 1.99: DE87003889	MN -20	12:12957
AFGL-TR-				
86-0195	*See* AD-A-172609/0/XAB			12:12562
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86-29	*See* AD-A-172793/2/XAB			12:12465
AIF/NESP-				
037	Atomic Industrial Forum, Inc., 7101 Wisconsin Ave., Bethesda, MD 20814-4891	TI87900319	ND -70B	12:10922
ANL-				
86-47	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87004148	STD -32	12:12982

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57	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003284	MN -90i	12:10790
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86-7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003969	STD -90e	12:10791
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86-113	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001550	MN -34D	12:12617
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85	NTIS, PC A03/MF A01; 1		DE87004032	MN -32	12:12983
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1	*See* N-86-31647				12:11578
ARL-TR-					
53	National Research Council of Canada, Ottawa, Ontario				12:10742
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8501	NTIS (US Sales Only), PC A03/MF A01		DE87750603	MN -38	12:11922
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18/ 86	*See* OEFZS-4373		DE87700449	MN -71	12:10944
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8664364	*See* N-86-32888				12:11113
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613-3641	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002951	MN -41	12:12313
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07967	NTIS, PC A02/MF A01; 1		DE87900428	MN -11	12:12280
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15026	NTIS (US Sales Only), MF A01; 2		DE87900427	MN -38	12:12014
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BHRA-RR-					
1962	BHRA Fluid Engineering, Cranfield, England				12:10785
2550	British Hydromechanics Research Association, Cranfield				12:10773
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2135	*See* NUREG/CR-4573		TI87900350	MN -25	12:11635
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614	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004150	STD -70	12:10923
624	NTIS, PC A08/MF A01; 1		DE87004144	STD -70	12:10924
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38686	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003202	MN -25	12:11602
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38826	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003228	MN -83	12:11446
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38853	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003472	MN -28	12:12075
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38875	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003491	MN -98B	12:10863
38889	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003235	MN -34D	12:12198
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38910	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003231	MN -34D	12:12618
38913	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003199	MN -70B	12:10925
38914	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003205	MN -28	12:12199
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38980	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003479	MN -48	12:12404
39020	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003489	MN -34D	12:12619
39091	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004176	MN -28	12:12076
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38839	NTIS, PC A02/MF A01 - GPO		TI87002582	MN -78	12:11325
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68-1330	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003562	MN -34D	12:12666
68-1406	*See* DOE/ER/25009-327	E 1.99:	DE87003563	MN -32	12:12987

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69-1407	*See* DOE/ER/25009-354	E 1.99:	DE87003560	MN -32	12:12884
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86-5	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario				12:10695
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082/ 85	NTIS (US Sales Only), PC A02/MF A01		DE87700406	MN -4	12:12533
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86-136	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900144	MN -28	12:12620
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0085	*See* N-86-31654				12:12013
CONCAWE-					
8/ 85	CONCAWE, Koningin Julianaplein 30, 2595 AA The Hague, Netherlands			ND -92	12:10869
CONF-8006284-	(Conference on development of passive solar test cell methodologies, Ispra, Italy, 12-14 Jun 1980)				
1	*See* DTH-LV-R-85-8			ND -59B	12:11073
CONF-821011-	(IEEE nuclear science symposium, Washington, DC, USA, 20-22 Oct 1982)				
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CONF-840302-	(11. annual energy technology conference and exposition, Washington, DC, USA, 19-21 Mar 1984)				
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003923	MN -93A	12:11502
CONF-8404319-	(4. Brazilian Congress of Engineering Geology, Belo Horizonte, Brazil, 23-27 Apr 1984)				
1	*See* INIS-BR-551		DE87700429	MN -51	12:10902
2	*See* INIS-BR-552		DE87700430	MN -51	12:10903
3	*See* INIS-BR-553		DE87700431	MN -51	12:10904
4	*See* INIS-BR-554		DE87700432	MN -51	12:10905
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CONF-840757-	(22. international conference on high energy physics, Leipzig, German D.R., 19-25 Jul 1984)				
40	*See* JINR-R-1-85-315		DE87700396	MN -34C	12:12819
CONF-8408211-	(Energy and U.S. industrial competitiveness in world markets conference, Aspen, CO, USA, 8-12 Aug 1984)				
Summ.	NTIS, PC A03; 3		DE87000740	MN -13	12:11460
CONF-840903-	(International gas research conference, Washington, DC, USA, 10-13 Sep 1984)				
	Government Institutes, Inc., 966 Hungerford Dr., No. 24, Rockville, MD 20850		T187002224	ND -92	12:10881
CONF-8410203-	(9. All-Union conference on charged particle accelerators, Dubna, USSR, 16-18 Oct 1984)				
Vol.2	*See* INIS-SU-369		DE87780052	MN -28	12:12019
CONF-8411198-	(Symposium on high temperature intermetallic compounds, Boston, MA, USA, 26-30 Nov 1984)				
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CONF-8411283-	(Regional workshop on nuclear techniques in crop production, Piracicaba, Brazil, 19-23 Nov 1984)				
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Absts.	*See* INIS-BR-567		DE87700442	MN -48	12:12441
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11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002225	MN -25	12:11603
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1-Summ.	*See* INIS-BR-558		DE87700440	MN -48	12:12334
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10	*See* TVA/PUB-87/4		DE87900336	MN -61E	12:11012
CONF-850157-	(Fusion Power Associates symposium on the search for attractive fusion concepts, La Jolla, CA, USA, 31 Jan-1 Feb 1985)				
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CONF-8504237-	(7. scientific conference on power industry of the Ingenieurhochschule Zittau, Zittau, German D.R., 16-18 Apr 1985)				
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CONF-850507-	(International conference on nuclear data for basic and applied science, Santa Fe, NM, USA, 13-17 May 1985)			
	Gordon and Breach, 50 West 23rd Street, New York, NY 10010			12:11449
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CONF-850617-	(9. symposium on thermophysical properties, Boulder, CO, USA, 24-27 Jun 1985)			
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27	*See* JINR-E-1-85-662	DE87700397	MN -34C	12:12705
CONF-850933-	(13. international conference on solid state nuclear track detectors, Rome, Italy, 23-27 Sep 1985)			
11	*See* HEDL-SA-3315-FP	E 1.99: DE87000248	MN -80	12:11239
CONF-850961-	(Gas and electricity markets in Europe: prospects and policies, Luxembourg, Luxembourg, 23-25 Sep 1985)			
1	*See* ESC-WR-85-28		ND -98	12:11558
CONF-8510324-	(13. annual Illinois energy conference, Chicago, IL, USA, 28-29 Oct 1985)			
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CONF-8510375-	(2. geology South Brazilian symposium, Florianopolis, Brazil, 1 Oct 1985)			
1	*See* INIS-BR-562	DE87700407	MN -4	12:12535
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CONF-8510381-	(Fuel cell workshop, Noordwijkerhout, Netherlands, 7-8 Oct 1985)			
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CONF-8511245-	(Offshore northern seas advanced projects conference, Stavanger, Norway, 19-21 Nov 1985)			
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4	*See* PNL-SA-13687	E 1.99: DE87002062	MN -41	12:12858
CONF-860213-	(6. symposium on the transfer and utilization of particulate control technology, New Orleans, LA, USA, 25-28 Feb 1986)			
Vol.2	*See* EPRI-CS-4918-Vol.2	TI87920154	ND -90	12:11186
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1	*See* SLAC-PUB-4126	E 1.99: DE87003671	MN -41	12:11939
CONF-8603154-	(2. status colloquium of the Project European Research Center for Air Pollution Abatement Measures (PEF) of Kernforschungszentrum Karlsruhe, Karlsruhe, F.R. Germany, 4-7 Mar 1986)			
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CONF-8603164-	(2. Arab congress of plant protection, Damascus, Syria, 24-27 Mar 1986)			
Absts.	*See* INIS-mf-10497	DE87780055	MN -41	12:12510
CONF-8603169-	(SHARE '66, Anaheim, CA, USA, 16-21 Mar 1986)			
1	*See* SLAC-PUB-3894	E 1.99: DE87003275	MN -32	12:13003
CONF-860421-	(2. international conference on fusion reactor materials (ICFRM-2), Chicago, IL, USA, 13-17 Apr 1986)			
20	*See* ORNL/TM-10126	E 1.99: DE86015969	STD -20c	12:11638
CONF-860467-	(Peer review of task group G on effects on materials of the National Acid Precipitation Assessment Program, Durham, NC, USA, 7-11 Apr 1986)			
Summ.	North Carolina State Univ., Acid Deposition Program, 1509 Varsity Drive, Raleigh, NC 27606	TI87900096	MN -11	12:12241
CONF-8604201-	(Antimatter physics at low energies, Batavia, IL, USA, 10-12 Apr 1986)			
7	*See* CERN-EP-86-136	DE87900144	MN -28	12:12620
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7	*See* UCRL-95396	E 1.99:	DE87003252	MN -38	12:11964
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CONF-8604278-	(36. conference on nuclear spectroscopy and nuclear structure, Khar'kov, USSR, 15-18 Apr 1986)				
Summs.	*See* INIS-SU-392		DE87780053	MN -34C	12:12691
CONF-860510-	(Symposium on heavy ion inertial fusion, Washington, DC, USA, 27-29 May 1986)				
20	*See* UCRL-94382	E 1.99:	DE87003257	MN -21	12:12961
21	*See* UCRL-94638	E 1.99:	DE87003256	MN -21	12:12962
CONF-860527-	(41. annual Purdue industrial waste conference, West Lafayette, IN, USA, 13-15 May 1986)				
3	*See* UCRL-95587	E 1.99:	DE87003240	MN -11	12:12295
CONF-860537-	(Symposium on science and engineering manpower in energy: labor market and education issues and outlook, Washington, DC, USA, 14 May 1986)				
	See DOE/ER-0300	E 1.99:	DE87002081	MN -13	12:11434
CONF-860575-	(2. conference on particle and nuclear physics, Lake Louise, Canada, 26-31 May 1986)				
61	*See* DOE/ER/40048-31-N6	E 1.99:	DE87000514	MN -34C	12:12759
CONF-8605145-	(International conference on the physics of phase space, College Park, MD, USA, 20-23 May 1986)				
5	*See* LA-UR-86-3628	E 1.99:	DE87001976	MN -32	12:12992
CONF-8605199-	(6. CNLS annual conference on nonlinearities in condensed matter, Los Alamos, NM, USA, 4-9 May 1986)				
6	*See* LA-UR-86-3827	E 1.99:	DE87002910	MN -34	12:12867
CONF-8605203-	(IAA '86: conference on instrumental activation analysis, Klucenice, Czechoslovakia, 4-8 May 1986)				
Absts.	*See* INIS-mf-10519		DE87700408	MN -4	12:11756
CONF-8605212-	(47. DAMSUL committee meeting, Miamisburg, OH, USA, 13-14 May 1986)				
1	*See* DPST-86-637		DE87002655	MN -23	12:11999
CONF-860601-	(4. international conference on emerging nuclear energy systems, Madrid, Spain, 30 Jun-4 Jul 1986)				
10	*See* UCRL-93786	E 1.99:	DE86016081	MN -21	12:12959
CONF-860634-	(Joint symposium on dry SO/sub 2/ and simultaneous SO/sub 2//NO/sub x/ control technologies, Raleigh, NC, USA, 2-6 Jun 1986)				
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CONF-860649-	(6. annual gasification contractors' meeting, Morgantown, WV, USA, 24-25 Jun 1986)				
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CONF-8606130-	(International conference on nuclear structure, reactions, and symmetries, Dubrovnik, Yugoslavia, 5-14 Jun 1986)				
12	*See* UCRL-95092	E 1.99:	DE87002160	MN -34C	12:12722
CONF-8606134-	(4. international conference on muon spin rotation, relaxation and resonance, Uppsala, Sweden, 1 Jun 1986)				
9	*See* LBL-22057	E 1.99:	DE87000077	MN -25	12:11593
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6	*See* BNL-39020	E 1.99:	DE87003489	MN -34D	12:12619
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3	*See* DOE/ER/40048-31-N6	E 1.99:	DE87000514	MN -34C	12:12759
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21	*See* BNL-38914	E 1.99:	DE87003205	MN -28	12:12199
22	*See* BNL-38910	E 1.99:	DE87003231	MN -34D	12:12618
23	*See* BNL-38889	E 1.99:	DE87003235	MN -34D	12:12198
CONF-8606241-	(3. Continuous Electron Beam Accelerator Facility summer school, Newport News, VA, USA, 23-27 Jun 1986)				
2	*See* BNL-38946	E 1.99:	DE87003232	MN -28	12:12200
CONF-8606245-	(Society for Industrial and Applied Mathematics workshop on multiphase flow, Leesburg, VA, USA, 2-4 Jun 1986)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87001559	MN -38	12:11987
CONF-860701-	(23. international conference on high-energy physics, Berkeley, CA, USA, 16-23 Jul 1986)				
32	*See* ANL-HEP-CP-86-113	E 1.99:	DE87001550	MN -34D	12:12617
65	*See* SLAC-PUB-4054		DE87003669	ND -34D	12:12639
CONF-860753-	(International conference on EXAFS and near edge structure, Saumur, France, 7-11 Jul 1986)				
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001535	MN -25	12:11749
CONF-860793-	(2. IAP recontre on nuclear astrophysics, Paris, France, 7-11 Jul 1986)				
2	*See* LA-UR-86-3512	E 1.99:	DE87001962	MN -34B	12:12569

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CONF-860798-	(International workshop on slow positron beam techniques for solid state and surface studies, Norwich, UK, 7-10 Jul 1986)			
1	*See* BNL-38796	E 1.99: DE87002140	MN -25	12:12585
CONF-8607100-	(NEUROCON 1 conference, San Jose, CA, USA, 27-30 Jul 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87000746	MN -48	12:12985
CONF-860806-	(8. international conference on solid state dosimetry, Oxford, UK, 26-29 Aug 1986)			
3	*See* PNL-SA-14187	E 1.99: DE87003405	MN -41	12:12514
CONF-860826-	(National meeting of the American Institute of Chemical Engineers, Boston, MA, USA, 24-27 Aug 1986)			
11	*See* BNL-38826	E 1.99: DE87003228	MN -83	12:11446
CONF-860832-	(11. international conference on few-body systems in particle and nuclear physics, Tokyo, Japan, 24-30 Aug 1986)			
9	*See* DOE/ER/05126-302	DE87002267	MN -34C	12:12756
CONF-860856-	(Conference on review of progress in quantitative NDE, San Diego, CA, USA, 3-8 Aug 1986)			
7	*See* EGG-M-11186	E 1.99: DE87000441	MN -38	12:12000
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001494	MN -25	12:11997
CONF-860864-	(Meeting on strongly coupled plasma physics, Santa Cruz, CA, USA, 4-9 Aug 1986)			
2	*See* UCRL-95790	E 1.99: DE87003439	MN -34A	12:12932
3	*See* UCRL-95796	E 1.99: DE87003440	MN -34A	12:12598
CONF-860880-	(30. SPIE technical symposium on optics and optoelectronic engineering, San Diego, CA, USA, 17-22 Aug 1986)			
41-Rev.1	*See* UCRL-95134-Rev.1	E 1.99: DE87003249	MN -38	12:11942
CONF-8608113-	(Short-term effects of reactor accidents: Chernobyl, Upton, NY, USA, 8-9 Aug 1986)			
Summs.	*See* BNL-52030	E 1.99: DE87003078	STD -48	12:12468
CONF-8608135-	(INS international symposium on hypernuclear physics, Tokyo, Japan, 20-23 Aug 1986)			
1	*See* BNL-38899	E 1.99: DE87003196	MN -34	12:12696
CONF-8608137-	(National Solar Observatory symposium, Sun Spot, NM, USA, 1 Aug 1986)			
1	*See* LA-UR-86-3796	E 1.99: DE87002915	MN -34B	12:12570
CONF-8608139-	(Conference on non-stoichiometric compounds: the chemistry, physics and technological uses of non-stoichiometric compounds, Keele, UK, 31 Aug-5 Sep 1986)			
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87001520	MN -25	12:11686
CONF-860905-	(International meeting on low, intermediate and high level waste management - decontamination and decommissioning, Niagara Falls, NY, USA, 14-18 Sep 1986)			
24	*See* DOE/SSDP-0012	E 1.99: DE87000419	MN -78	12:11329
26	*See* BNL-38913	E 1.99: DE87003199	MN -70B	12:10925
CONF-860908-	(Operability of nuclear power systems in normal and adverse environments meeting, Albuquerque, NM, USA, 29 Sep-3 Oct 1986)			
34	*See* BNL-NUREG-38841	TI87002585	MN -78	12:11219
35	*See* BNL-NUREG-38839	TI87002582	MN -78	12:11325
36	*See* BNL-NUREG-38871	TI87002583	MN -78	12:11326
CONF-860914-	(Applied superconductivity conference (ASC '86), Baltimore, MD, USA, 28 Sep-4 Oct 1986)			
18	*See* LBL-21294	DE87002565	MN -28	12:12162
20	*See* UCRL-94217	E 1.99: DE87003394	MN -20a	12:12960
21	*See* BNL-38853	E 1.99: DE87003472	MN -28	12:12075
CONF-860917-	(14. SOFT - symposium on fusion technology, Avignon, France, 8-12 Sep 1986)			
12-Vugraphs	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001686	MN -20	12:12944
CONF-860944-	(29. conference on analytical chemistry in energy technology, Knoxville, TN, USA, 29 Sep-2 Oct 1986)			
3	*See* DP-MS-86-86	E 1.99: DE87003113	MN -38	12:11934
CONF-8609127-	(SPIE's fiber LASE '86, Cambridge, MA, USA, 14-26 Sep 1986)			
15	*See* UCRL-95327	E 1.99: DE87000598	MN -38	12:11943
CONF-8609131-	(8. international free electron laser conference, Glasgow, UK, 1-5 Sep 1986)			
9	*See* BNL-38939	E 1.99: DE87003208	MN -28	12:11956
10	*See* UCRL-95775	E 1.99: DE87003396	MN -34	12:11966
CONF-8609163-	(International conference and symposia on unified concepts of many-body problems, Stony Brook, NY, USA, 4-6 Sep 1986)			
5	*See* BNL-38936	E 1.99: DE87003234	MN -34	12:12643
CONF-8609173-	(2. conference on hypercube multiprocessors, Knoxville, TN, USA, 29-30 Sep 1986)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002817	MN -32	12:12986

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CONF-8609191-	(Seminar on the cycling of long-lived radionuclides in biosphere: observation and models, Madrid, Spain, 15-19 Sep 1986)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001836	MN -11	12:12299
CONF-8609193-	(NATO advanced research workshop on acid deposition processes at high elevation sites, Edinburgh, UK, 8-12 Sep 1986)			
2	*See* BNL-38800	E 1.99: DE87001463	MN -11	12:12239
CONF-8609200-	(5. thematic conference on remote sensing for exploration geology, Reno, NV, USA, 29 Sep-1 Oct 1986)			
2	*See* PNL-SA-13833	E 1.99: DE87003303	MN -11	12:12555
CONF-8609203-	(International symposium on in vivo body composition studies, Upton, NY, USA, 28 Sep-1 Oct 1986)			
3	*See* BNL-38980	E 1.99: DE87003479	MN -48	12:12404
CONF-8609206-	(7. IFAC workshop on distributed computer control systems, Bonn, F.R. Germany, 29 Sep-3 Oct 1986)			
1	*See* UCRL-95441	E 1.99: DE87002553	MN -32	12:13006
CONF-8609207-	(Conference on the physics of multiple charged ions, Groningen, Netherlands, 17-19 Sep 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001689	MN -34	12:12586
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000994	MN -34A	12:12587
CONF-8609208-	(ASTM workshop on heat flow sensors, Philadelphia, PA, USA, 19-23 Sep 1986)			
1	*See* LBL-17376	E 1.99: DE87002576	MN -95d	12:11524
CONF-8609212-	(3. international conference on physics of magnetic materials, Szczyrk-Bita, Poland, 9-14 Sep 1986)			
1	*See* KFKI-1986-77/E	DE87900268	MN -25	12:11626
2	*See* KFKI-1986-78/E	DE87900269	MN -25	12:11627
CONF-8609213-	(1. advanced summer school on finite elements in physics, Lausanne, Switzerland, 1 Sep 1986)			
1	*See* LRP-304/86	DE87900205	MN -20	12:12929
CONF-8609215-	(Ispra courses: regional and long-range transport of air pollution, Ispra, Varese, Italy, 15-19 Sep 1986)			
1	*See* BNL-38847	E 1.99: DE87003213	MN -11	12:12240
CONF-8609217-	(Neutral particle beam annual program review, Los Alamos, NM, USA, 30 Sep-2 Oct 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000520	MN -25	12:11608
CONF-861004-	(18. Society for the Advancement of Materials and Process Engineering national technical conference on materials, Seattle, WA, USA, 7-9 Oct 1986)			
6	*See* MLM-3400(OP)	E 1.99: DE87003024	MN -25	12:11718
CONF-861007-	(Nuclear science and nuclear power systems symposium, Washington, DC, USA, 29-31 Oct 1986)			
8	*See* EGG-M-13986	E 1.99: DE87002608	MN -80	12:11331
14	*See* SLAC-PUB-4109	E 1.99: DE87002846	MN -38	12:12007
16	*See* BNL-38861	E 1.99: DE87003207	MN -37	12:12197
17	*See* EGG-M-13686	E 1.99: DE87002612	MN -78	12:11330
19	*See* UCRL-95481	E 1.99: DE87002389	MN -41	12:12275
CONF-861019-	(10. international vacuum congress and 6. international conference on solid surfaces and the 33. national symposium of the American Vacuum Society, Baltimore, MD, USA, 27-31 Oct 1986)			
17	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002181	MN -20	12:12945
20	*See* PNL-SA-14040	E 1.99: DE87002472	MN -4	12:11869
21	*See* BNL-38686	E 1.99: DE87003202	MN -25	12:11602
CONF-861066-	(47. international water conference, Pittsburgh, PA, USA, 27-29 Oct 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002403	MN -11	12:12343
CONF-861076-	(Fall meeting of the Metallurgical Society of AIME, Orlando, FL, USA, 5-9 Oct 1986)			
2	*See* DOE/NASA/16310-1	E 1.99: DE87003578	STD -25	12:11615
CONF-861097-	(ASCE national meeting on computing in civil engineering, Boston, MA, USA, 27-31 Oct 1986)			
3-Rev.6	*See* DP-MS-86-150-Rev.6-86	E 1.99: DE87002648	MN -70	12:10935
CONF-8610110-	(15. international colloquium on group theoretical methods in physics, Philadelphia, PA, USA, 20-24 Oct 1986)			
2	*See* BNL-38864	E 1.99: DE87003236	MN -34C	12:12752
CONF-8610115-	(4. international symposium on the production and neutralization of negative ions and beams, Upton, NY, USA, 27-31 Oct 1986)			
5	*See* UCRL-95564	E 1.99: DE87003246	MN -34A	12:12596
6	*See* UCRL-95563	E 1.99: DE87003245	MN -34A	12:12595
7	*See* TRI-PP-86-107	DE87900304	MN -28	12:12167
CONF-8610135-	(14. water reactor safety information meeting, Gaithersburg, MD, USA, 27-31 Oct 1986)			
27	*See* EGG-M-34586	E 1.99: DE87002614	MN -78	12:11332
39	*See* BNL-NUREG-38934	TI87003230	MN -78	12:11327
40	*See* SAND-86-2129C	E 1.99: DE87002487	MN -78	12:11409
Summs.	*See* NUREG/CP-0081	TI87900064	MN -78	12:11399
CONF-8610144-	(DOE/ORO contractors' environmental protection waste management workshop, Oak Ridge, TN, USA, 28-29 Oct 1986)			
Absts.	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87001811	MN -11	12:12300

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CONF-8610150-	(Workshop on heavy-ion physics and instrumentation for a 15-TM booster and storage ring, Oak Ridge, TN, USA, 2-4 Oct 1986)			
Summ.	NTIS, PC A05; 3	DE87002594	MN -28	12:12689
CONF-8610160-	(IAEA technical committee meeting on gas-cooled reactors and their applications, Juelich, F.R. Germany, 20-23 Oct 1986)			
2	*See* GA-A-18633	E 1.99: DE87000915	MN -77	12:11233
3	*See* GA-A-18643	E 1.99: DE87001317	MN -77	12:11375
CONF-8610173-	(11. conference on cyclotrons and their applications, Tokyo, Japan, 13-17 Oct 1986)			
2	*See* TRI-PP-86-89	DE87900302	MN -28	12:12163
3	*See* TRI-PP-86-94	DE87900309	MN -28	12:12073
4	*See* TRI-PP-86-96	DE87900310	MN -28	12:12074
5	*See* TRI-PP-86-97	DE87900308	MN -28	12:12166
6	*See* TRI-PP-86-98	DE87900307	MN -28	12:12049
8	*See* TRI-PP-86-93	DE87900314	MN -28	12:12165
9	*See* TRI-PP-86-92	DE87900313	MN -28	12:12072
10	*See* TRI-PP-86-90	DE87900312	MN -28	12:12164
CONF-8610174-	(5. symposium on environmental radiochemical analysis, Harwell, UK, 1-3 Oct 1986)			
1	*See* DP-MS-85-157	E 1.99: DE87002657	MN -11	12:12301
CONF-8610179-	(Washington State Public Health Association meeting, Pasco, WA, USA, 23 Oct 1986)			
1	*See* PNL-SA-14415	E 1.99: DE87003098	MN -41	12:12515
CONF-8610180-	(Fall meeting of the Western States Section/Combustion Institute, Tucson, AZ, USA, 27-28 Oct 1986)			
1	*See* LBL-21899	E 1.99: DE87001885	MN -4	12:11908
CONF-8610182-	(Annual symposium on safeguards of nuclear material, Richland, WA, USA, 14 Oct 1986)			
1	*See* UNI-SA-183	E 1.99: DE87002690	MN -16	12:10986
CONF-8610183-	(LAMPF users group meeting, Los Alamos, NM, USA, 1 Oct 1986)			
1	*See* DOE/ER/40048-05-N7	E 1.99: DE87003134	MN -34C	12:12758
CONF-8610184-	(Conference on quantum fluids and solids, Banff, Canada, 13-17 Oct 1986)			
1	*See* LA-UR-86-3785	E 1.99: DE87002918	MN -34A	12:12611
CONF-8610185-	(Autumn school on few-body methods, Lisbon, Portugal, 13-21 Oct 1986)			
1	*See* LA-UR-86-3946	E 1.99: DE87002901	MN -34C	12:12636
CONF-8610186-	(9. symposium on statistics and the environment risk assessment and public policy, Washington, DC, USA, 27-28 Oct 1986)			
1	*See* UCRL-95692	E 1.99: DE87003242	MN -48	12:12527
CONF-8610189-	(Conference on surface and borehole geophysical methods and groundwater instrumentation, Denver, CO, USA, 15-17 Oct 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001683	MN -70	12:10927
CONF-8610196-	(European workshop on few body physics, Rome, Italy, 7-11 Oct 1986)			
1	*See* SLAC-PUB-4134	E 1.99: DE87003267	MN -34C	12:12699
CONF-861102-	(American Nuclear Society and Atomic Industrial Forum joint meeting, Washington, DC, USA, 16-21 Nov 1986)			
27	*See* EGG-M-35186	E 1.99: DE87002609	MN -70	12:10912
CONF-861114-	(9. international conference on application of accelerators in research and industry, Denton, TX, USA, 10-12 Nov 1986)			
34	*See* PNL-SA-14084	E 1.99: DE87003306	MN -34A	12:12591
CONF-861132-	(10. symposium on flue gas desulfurization, Atlanta, GA, USA, 18-21 Nov 1986)			
1	*See* TVA/OP/PMO-87/1	DE87900341	MN -11	12:11438
CONF-861165-	(5. joint conference on applications of air pollution meteorology, Chapel Hill, NC, USA, 18-21 Nov 1986)			
6	*See* PNL-SA-13806	DE87003305	MN -11	12:12260
CONF-861177-	(9. international conference on lasers and applications, Orlando, FL, USA, 3-7 Nov 1986)			
1	*See* UCRL-94737	E 1.99: DE87003253	MN -38	12:12003
CONF-861194-	(DNA workshop on smoke emissions and properties, Gaithersburg, MD, USA, 13-14 Nov 1986)			
1	*See* UCRL-95645	E 1.99: DE87002757	MN -11	12:12261
CONF-861195-	(29. meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO), Amarillo, TX, USA, 18-20 Nov 1986)			
1	*See* SAND-86-2623C	E 1.99: DE87002482	MN -38	12:12002
CONF-861196-	(28. annual meeting of the American Vacuum Society, Baltimore, MD, USA, 3-7 Nov 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000396	MN -20	12:12946
CONF-861197-	(ICALEO '86: laser application conference, Arlington, VA, USA, 10-13 Nov 1986)			
1	*See* UCRL-95516	E 1.99: DE87001359	MN -38	12:11965

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CONF-861139-	(Interagency mechanical operations group fall meeting, Livermore, CA, USA, 11-13 Nov 1986)			
1	*See* UCRL-95672	E 1.99: DE87002808	MN -38	12:11944
CONF-8611101-	(14. annual conference of the Department of Energy/ contractors micrographics and Information Management Association, Pleasanton, CA, USA, 4-7 Nov 1986)			
1	*See* K/CSD/INF-86/19P	E 1.99: DE87000760	MN -13	12:12969
CONF-8611103-	(20. symposium of North Eastern Accelerator Personnel, Notre Dame, IN, USA, 3-6 Nov 1986)			
1	*See* DOE/ER/40124-11	E 1.99: DE87003133	MN -28	12:12146
CONF-861207-	(Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986)			
13	*See* LA-UR-86-3778	E 1.99: DE87002919	MN -4	12:11816
21	*See* IS-M-589	E 1.99: DE87001837	MN -25	12:11716
CONF-861211-	(American Society of Mechanical Engineers winter meeting, Anaheim, CA, USA, 7-12 Dec 1986)			
19	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000862	MN -90h	12:12011
CONF-861240-	(3. national conference on high power microwave technology for defense applications, Albuquerque, NM, USA, 1-5 Dec 1986)			
1	*See* UCRL-95734	E 1.99: DE87002584	MN -38	12:12009
2	*See* UCRL-95668	E 1.99: DE87003255	MN -38	12:12008
3	*See* UCRL-93077	E 1.99: DE87003397	MN -38	12:12582
CONF-861241-	(International scientific forum on fueling the 21st century, New Orleans, LA, USA, 1-5 Dec 1986)			
1	*See* SAND-86-2773C	E 1.99: DE87003029	MN -98B	12:10868
CONF-861242-	(International conference on soft X-ray optics and technology, West Berlin, F.R. Germany, 8-11 Dec 1986)			
1	*See* LA-UR-86-3978	DE87002900	MN -25	12:11630
CONF-870201-	(Central hardwood forest conference, Knoxville, TN, USA, 24-26 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86007237	MN -11	12:12281
CONF-870204-	(Society of Automotive Engineers international congress and expo, Detroit, MI, USA, 23-27 Feb 1987)			
1	*See* LA-UR-86-3572	E 1.99: DE87001968	MN -38	12:11583
CONF-870208-	(6. annual IEEE Phoenix conference on computers and communications, Scottsdale, AZ, USA, 25-27 Feb 1987)			
1	*See* SAND-86-0586C	E 1.99: DE86012655	MN -32	12:13000
CONF-870219-	(Midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines, Reno, NV, USA, 8-12 Feb 1987)			
1	*See* LA-UR-86-3493	E 1.99: DE87001961	MN -37	12:12204
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002413	MN -41	12:12332
4	*See* UCRL-95043	E 1.99: DE87002756	MN -41	12:12859
5	*See* LA-UR-86-3777	E 1.99: DE87002920	MN -41	12:12857
CONF-870220-	(Southwest optics conference, Albuquerque, NM, USA, 9-13 Feb 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001834	MN -34A	12:12860
2	*See* SAND-86-2485C	E 1.99: DE87001735	MN -34	12:11961
3	*See* SAND-86-2458C	E 1.99: DE87002051	MN -38	12:11960
4	*See* SAND-86-2488C	DE87003040	MN -25	12:11688
5	*See* SAND-86-2487C	E 1.99: DE87003153	MN -25	12:11731
6	*See* SAND-86-2501C	E 1.99: DE87002699	MN -25	12:12594
CONF-870235-	(3. international conference on stratified flows, Pasadena, CA, USA, 3-5 Feb 1987)			
1	*See* UCRL-95582	E 1.99: DE87002377	MN -34B	12:12613
2	*See* UCRL-95629	E 1.99: DE87002551	MN -32	12:13007
CONF-870238-	(2. multidisciplinary conference on sinkholes and the environmental impacts of karst, Orlando, FL, USA, 9-11 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002812	MN -70	12:10926
CONF-870239-	(15. power industry computer application conference, Montreal, Canada, 1 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001320	MN -32	12:12984
CONF-870308-	(General meeting of the American Physical Society, New York, NY, USA, 16-20 Mar 1987)			
1	*See* UCRL-95773	E 1.99: DE87003441	MN -34A	12:12597
CONF-870358-	(International conference on energy transformation and interaction with small and mesoscale atmospheric processes, Lausanne, Switzerland, 2-6 Mar 1987)			
1	*See* UCRL-94994	E 1.99: DE87003469	MN -11	12:12229
CONF-870405-	(Radiation protection and shielding conference, Knoxville, TN, USA, 22-24 Apr 1987)			
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000232	MN -41	12:12314
CORR-85-00484	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87003115	MN -11	12:12242
CTA-IEAV-NT-04/ 85	NTIS (US Sales Only), PC A03/MF A01	DE87700452	MN -28	12:12020
CTA-IEAV-RP-020/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87700456	MN -80	12:11238

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DFVLR-FB-CONF-870219-				**CONF-870219-**
CONF-870219-	(Midyear topical symposium of the Health Physics Society: health physics of radiation-producing machines, Reno, NV, USA, 8-12 Feb 1987)			
1	*See* LA-UR-86-3493	E 1.99: DE87001961	MN -37	12:12204
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002413	MN -41	12:12332
4	*See* UCRL-95043	E 1.99: DE87002756	MN -41	12:12859
5	*See* LA-UR-86-3777	E 1.99: DE87002920	MN -41	12:12857
CONF-870220-	(Southwest optics conference, Albuquerque, NM, USA, 9-13 Feb 1987)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001834	MN -34A	12:12860
2	*See* SAND-86-2485C	E 1.99: DE87001735	MN -34	12:11961
3	*See* SAND-86-2458C	E 1.99: DE87002051	MN -38	12:11960
4	*See* SAND-86-2488C	DE87003040	MN -25	12:11688
5	*See* SAND-86-2487C	E 1.99: DE87003153	MN -25	12:11731
6	*See* SAND-86-2501C	E 1.99: DE87002699	MN -25	12:12594
CONF-870235-	(3. international conference on stratified flows, Pasadena, CA, USA, 3-5 Feb 1987)			
1	*See* UCRL-95582	E 1.99: DE87002377	MN -34B	12:12613
2	*See* UCRL-95629	E 1.99: DE87002551	MN -32	12:13007
CONF-870238-	(2. multidisciplinary conference on sinkholes and the environmental impacts of karst, Orlando, FL, USA, 9-11 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002812	MN -70	12:10926
CONF-870239-	(15. power industry computer application conference, Montreal, Canada, 1 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001320	MN -32	12:12984
CONF-870308-	(General meeting of the American Physical Society, New York, NY, USA, 16-20 Mar 1987)			
1	*See* UCRL-95773	E 1.99: DE87003441	MN -34A	12:12597
CONF-870358-	(International conference on energy transformation and interaction with small and mesoscale atmospheric processes, Lausanne, Switzerland, 2-6 Mar 1987)			
1	*See* UCRL-94994	E 1.99: DE87003469	MN -11	12:12229
CONF-870405-	(Radiation protection and shielding conference, Knoxville, TN, USA, 22-24 Apr 1987)			
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000232	MN -41	12:12314
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CTA-IEAV-RP- 020/ 85	NTIS (US Sales Only), PC A02/MF A01	DE87700456	MN -80	12:11238
DFVLR-FB- 85-10	*See* ESA-TT-29			12:11989
DHEW/PUB/NIOSH- 78-187	*See* PB-87-108338/XAB			12:12430
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DOE/CE/15239- T6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002517	MN -63	12:11025
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3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003907	MN -25	12:12201
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0026	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87003695	STD -41	12:12470
0027	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87003696	STD -41	12:12471
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0035(86/ 09)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87003896	MN -98	12:11463
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0125(86/ 3Q)	NTIS, PC A06/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87004097	MN -98A	12:10833
0130(86/ 10)	NTIS, PC A09/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87004095	MN -98C	12:10884
0131(85)	NTIS, PC A13/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87003339	MN -98C	12:10885
0226(86/ 09)	NTIS, PC A03/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87003897	MN -98E	12:11468
0380(86/ 10)	NTIS, PC A08/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87004096	MN -98B	12:10862
0487(85) / 1	NTIS, PC A07 - GPO; 3	DE87003786	MN -98B	12:10865
0497	NTIS, PC A04/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE87004099	MN -98	12:11433
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T1	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99: DE87003327	MN -34	12:12690
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452	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87003322	MN -34D	12:12621
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130	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003380	MN -34C	12:12701
132	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003381	MN -34D	12:12622
133	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87003382	MN -34D	12:12623
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361	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003558	MN -34D	12:12645
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DOE/ER/40120-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87003458	MN -28	12:12052
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DOE/ER/45149-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003452	MN -25	12:11610
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DOE/ER/45208-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003916	MN -25	12:11752
DOE/ER/45217-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003794	MN -25	12:11709
DOE/ER/52111-1-10/ 86	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87003417	MN -20	12:12947
DOE/ER/53161-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003358	MN -20	12:12911
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DOE/ER/53211-122	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87003572	MN -21	12:12913
DOE/ER/53223-17	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003419	MN -20f	12:12914
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99	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87004147	STD -20f	12:12915
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101	NTIS, PC A03; 3	DE87004143	STD -20f	12:12950
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DOE/ET/12139-T2	NTIS, PC A23/MF A01; 1 (GPO Dep.)	E 1.99: DE87003866	MN -11	12:12534
DOE/ET/13146-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003795	MN -34	12:12885
DOE/ET/14928-2233	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87002508	STD -90c	12:10702
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DOE/JPL/955843-82/ 1-Final	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87003821	MN -63b	12:11044
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DOE/LLW-59T	NTIS, PC A07/MF A01; 1	DE87004149	STD -70B	12:10929
DOE/MA-0276	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003698	MN -13	12:12975
DOE/MC/03193-2211	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87001024	STD -90	12:10770
DOE/MC/21167-2080	NTIS, PC AA07/MF A01; 1 (GPO Dep.)	E 1.99: DE87001041	MN -93A	12:11503

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DOE/MC/21388-2227	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87001037	MN -90i	12:11181
DOE/MC/22221-2210	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001023	MN -92	12:10889
DOE/MC/22224-2202	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87001036	STD -93A	12:11504
DOE/MC/22250-2215	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87001025	STD -90h	12:10706
DOE/METC-86/ 2019	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86001041	STD -90c	12:10707
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86/ 6049	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99: DE86006553	MN -90c	12:10709
86/ 6050	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99: DE86006554	MN -90c	12:10710
86/ 6057	NTIS, PC A22/MF A01; 1 (GPO Dep.)	E 1.99: DE86006561	MN -91	12:10890
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86/ 6059	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE86006563	MN -91	12:10892
86/ 6070	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86006595	MN -91	12:10893
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DOE/NASA/16310-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003578	STD -25	12:11615
DOE/NBB-0081	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87003699	STD -11	12:12244
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DOE/NE/44345-1-00/ 86	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002781	MN -70	12:10930
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DOE/PC/70788-T5	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87001708	MN -90d	12:10720
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DOE/PC/80522-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003437	MN -90a	12:10745
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DOE/PC/80528-T6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003363	MN -90e	12:10826
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DOE/PC/81201-T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003451	MN -90a	12:10723
DOE/PC/90502-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87004012	MN -90a	12:10746
DOE/PC/90515-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004102	MN -90a	12:11753
DOE/PC/90753-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003371	MN -90i	12:10759
DOE/PC/90911-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003432	MN -90d	12:10724
DOE/PC/90960-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003861	MN -90b	12:10747
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DOE/S-0053	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002843	MN -80	12:11203
DOE/SF/12217-1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003398	MN -59A	12:11071
DOE/SF/12221-T6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003188	MN -61G	12:10999
DOE/SF/15603-1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003852	MN -66	12:11096
DOE/SF/16299-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003434	MN -66	12:11091
DOE/SR/00001-T120	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002660	MN -4	12:11754
DOE/SSDP-0012	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87000419	MN -78	12:11329
DOE/WIPP-86-004	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004223	MN -70	12:10931
86-010	NTIS, PC A24/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003412	MN -70	12:10932
86-010-App.	NTIS, PC A99; 3		DE87003365	MN -70	12:10933
DOE/WM/46642-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002041	MN -70	12:10934
DOT/FAA/CT-86/ 7	*See* AD-A-172183/6/XAB				12:10860
DP-1730	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003779	STD -11	12:12336
DP-MS-85-157	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002657	MN -11	12:12301
86-86	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003113	MN -38	12:11934
86-150-Rev.6-86	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002648	MN -70	12:10935
DPST-86-637	NTIS, PC A02; 3		DE87002655	MN -23	12:11999
DTH-ISVA-39	NTIS (US Sales Only), PC A09/MF A01; 1		DE87750593	MN -64	12:12015
DTH-LBM-TR-143	Danmarks Tekniske Hoejskole. Lab. for Bygningsmaterialer, DK-2800 Lyngby, Denmark			ND -90i	12:11556
DTH-LET-RE-86-6	Danmarks Tekniske Hoejskole, Lab. for Energiteknik, Bygning 403, DK-2800 Lyngby, Denmark			ND -94a	12:11418
86-7	Danmarks Tekniske Hoejskole, Laboratoriet for Energiteknik, Bygning 403, DK-2800 Lyngby, Denmark			ND -96	12:11581
DTH-LV-171	Danmark Tekniske Hoejskole. Themarmal Insulation Lab., DK-2800 Lyngby, Denmark			ND -95d	12:11518
175	NTIS (US Sales Only), PC A12/MF A01; 1		DE87750611	MN -59B	12:11072
DTH-LV-R-85-5	NTIS (US Sales Only), PC A02/MF A01; 1		DE87750614	MN -59A	12:11081
85-7	Danmarks Tekniske Hoejskole, Lab. for Varmeisolering, DK-2800 Lyngby, Denmark			ND -59A	12:11082
85-8	Danmarks Tekniske Hoejskole, Lab. for Varmeisolering, DK-2800 Lyngby, Denmark			ND -59B	12:11073
85-16	Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering			ND -95d	12:11074
85-17	NTIS (US Sales Only), PC A03/MF A01; 1		DE87750613	MN -59A	12:11083
ECN-85-184	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND -90i	12:10760
86-040	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND -90e	12:10828
186	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND -11	12:12234
187	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND -11	12:12246
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EFI-726(41) -84	NTIS (US Sales Only), PC A02/MF A01		DE87700374	MN -34D	12:12651
728(43) -84	NTIS (US Sales Only), PC A02/MF A01		DE87700366	MN -34D	12:12652
744(59) -84	NTIS (US Sales Only), PC A02/MF A01		DE87700341	MN -34A	12:11710

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35186	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002609	MN -70	12:10912
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85/ 9	NTIS (US Sales Only), PC A04/MF A01; 1		DE87900401	MN -61F	12:11000
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EPA-					
600/ 7-84-001	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011233	STD -90i	12:11906
600/ 8-86/ 036	*See* PB-87-119343/XAB				12:11191
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4826	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920097	ND -93	12:12018
4827	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920143	ND -90f	12:10853
4834	NTIS, PC A03/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99:	DE87004105	MN -90	12:11001
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4921	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920110	ND -64	12:11070
4948	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920144	ND -94c	12:11420
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3342-Vol.5	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920101	ND -90d	12:10761
4252-Vol.3	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920105	ND -90	12:11119
4778	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920151	ND -90f	12:11151
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4847	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920108	ND -90	12:11182
4860	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920104	ND -90e	12:11152
4861-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920146	ND -90	12:11183
4861-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920147	ND -90	12:11184
4862	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920149	ND -90	12:11153
4914	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920111	ND -90e	12:11154
4918-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920153	ND -90	12:11185
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4966-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920156	ND -90e	12:11187
4969	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920157	ND -90h	12:11155
4975	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920150	ND -90b	12:10698
EPRI-EA-					
4906	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920113	ND -11	12:12325
4944-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920158	ND -97	12:11472
EPRI-EL-					
4286-Vol.6	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920168	ND -97d	12:11935
4650	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920166	ND -97c	12:11196
4876	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920121	ND -97e	12:11022
4909	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920164	ND -97d	12:11616
4920-CCM	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920163	ND -97b	12:11117
4953	Research Reports Center, Box 50490, Palo Alto, CA 94303		TI87920167	ND -97b	12:11197

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4956	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920160	ND -97a	12:11198
4984	Research Reports Center, Box 50490, Palo Alto, 94303	TI87920159	ND -97a	12:11199
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4858-Vol.1	Research Report Center, Box 50490, Palo Alto, CA 94303	TI87920123	ND -97	12:11200
EPRI-EM-				
4884	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920125	ND -98E	12:11473
4908	NTIS, PC A05/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87004108	MN -95d	12:11519
4915	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920169	ND -38	12:11712
4923-CCM	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920171	ND -95f	12:11575
4989	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920172	ND -13	12:11475
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4768	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920136	ND -78	12:11206
4830	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920130	ND -85	12:10913
4855	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920133	ND -78	12:11370
4874-Vol.2	NTIS, PC A08/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87003330	MN -78	12:11304
4883M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920139	ND -78	12:11208
4886	NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87003331	MN -70	12:10936
4888	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920138	ND -80	12:11244
4904	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920174	ND -78	12:11220
4928	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920137	ND -80	12:11245
4954	Research Reports Center, Box 50490 Palo Alto, CA 94303	TI87920178	ND -70	12:10937
4955	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920180	ND -78	12:11221
4967M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87004111	ND -78	12:11371
4974	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920183	ND -78	12:11372
4976	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920185	ND -78	12:11373
4978-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920184	ND -78	12:11617
ERL-				
86006	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750592	MN -96	12:11548
ERP/CRL-				
85-28(TR)	Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.			12:10774
85-108	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10775
86-1	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10776
86-3	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10777
86-9(TR,J)	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10699
86-17(IR)	Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.			12:10778
86-26(TR)	Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.			12:10779
86-39(OP,J)	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10765
86-45(TR)	Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.			12:10780
86-46(OP,J)	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10781
86-50(J,OP)	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10748
86-71(TR)	Canada Centre for Mineral and Energy Technology Sydney, Nova Scotia. Cape Breton Coal Research Lab.			12:10749

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85-58	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			12:10725
ESA-CR(P)-				
184	NTIS, PC A05/MF A01			12:11958
2182	*See* FOK-TR-R-5-068			12:11045
ESA-TT-				
10	NTIS, PC A09/MF A01			12:11907
29	NTIS, PC A06/MF A01; original German version available from DFVLR, Cologne, West Germany DM 28			12:11989
ESC-				
36	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -95f	12:11557
ESC-WR-				
85-18	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	12:11173
85-24	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -95d	12:11577
85-27	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -11	12:11587
85-28	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	12:11558
86-20	Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -92	12:10886
ETN-				
6-97255	NTIS, PC A02/MF A01			12:11061
6-97374	NTIS, PC A04/MF A01			12:12016
6-97375	NTIS, PC A03/MF A01			12:11959
6-97377	NTIS, PC A05/MF A01			12:11618
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1570-P27	British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -97e	12:11099
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8859	European Community Information Service, 2100 M St., N.W., Suite 707, Washington, DC 20037		ND -95f	12:11559
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9810-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20057			12:10727
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10387-IT	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -98D	12:11479
10390-EN/ FR	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -97d	12:11174
10428-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20057				12:10728
10501-EN/ DE	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -97	12:11190
10549-FR	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -38	12:11937
10570-IT	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -11	12:12278
10595-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -93	12:11505
10622-FR	Commission of the European Communities, Luxembourg				12:10729
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FEI-					
1603	NTIS (US Sales Only), PC A02/MF A01		DE87700399	MN -34C	12:12716
1636	NTIS (US Sales Only), PC A02/MF A01		DE87700446	MN -38	12:11990
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1642	NTIS (US Sales Only), PC A02/MF A01		DE87700447	MN -38	12:11991
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FMPC-					
2040-Rev.1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003986	MN -70	12:10938
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1429	NTIS, PC A06; 3		DE87003967	STD -28	12:12147
1431	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003783	STD -28	12:12148
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293	*See* DOE/ET/53193-6	E 1.99:	DE87004317	MN -20a	12:12917
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1881	NTIS (US Sales Only), PC A10/MF A01		DE87750978	MN -92	12:10867
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2092	NTIS (US Sales Only), PC A06/MF A01		DE87750979	MN -92	12:10873
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18133	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004042	STD -20c	12:12951
18633	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87000915	MN -77	12:11233
18643	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87001317	MN -77	12:11375
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31-6190	*See* DOE/NASA-0181	E 1.99:	DE87003993	MN -96	12:11065
GAT-T-					
3397	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87004214	MN -38	12:11938
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24	NTIS, PC A08/MF A01; 1		DE87004043	STD -70A	12:10980
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4068	*See* AD-A-173188/4/XAB				12:11919
GTFR-					
67	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003565	MN -20g	12:12918
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2087	*See* AD-A-173515/8/XAB				12:11600
HEDL-SA-					
3315-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87000248	MN -80	12:11239
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84-132-1703	*See* PB-87-108064/XAB				12:12257
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HW-				
49195	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86010090	MN -11	12:10963
IA-				
146/ 86	*See* OEFZS-345			12:11722
IAE-				
3870/ 4	NTIS (US Sales Only), PC A02/MF A01	DE87700378	MN -46	12:12837
3878/ 2	NTIS (US Sales Only), PC A02/MF A01	DE87700380	MN -34C	12:12763
3942/ 4	NTIS (US Sales Only), PC A03/MF A01	DE87700379	MN -46	12:12838
4051/ 16	NTIS (US Sales Only), PC A02/MF A01	DE87700358	MN -20	12:12919
4058/ 1	NTIS (US Sales Only), PC A03/MF A01	DE87700339	MN -34A	12:12589
4089/ 7	NTIS (US Sales Only), PC A02/MF A01	DE87700353	MN -20	12:12920
4094/ 1	NTIS (US Sales Only), PC A02/MF A01	DE87700318	MN -34D	12:12886
4100/ 7	NTIS (US Sales Only), PC A02/MF A01	DE87700355	MN -20	12:12921
4106/ 15	NTIS (US Sales Only), PC A02/MF A01	DE87700364	MN -20	12:12952
4130/ 6	NTIS (US Sales Only), PC A03/MF A01	DE87700359	MN -20	12:12922
4134/ 4	NTIS (US Sales Only), PC A03/MF A01	DE87700419	MN -25	12:11621
ICS-				
8606	*See* AD-A-173501/8/XAB			12:12980
8610	*See* AD-A-172196/8/XAB			12:12976
IEA/ICEAS-				
D3	NTIS, PC A05/MF A01; 1	DE87900392	STD -90	12:10835
IFVE-OTF-				
85-133	NTIS (US Sales Only), PC A02/MF A01	DE87700321	MN -34D	12:12887
85-162	NTIS (US Sales Only), PC A04/MF A01	DE87700322	MN -34D	12:12888
IHZ-WIK-				
85-533/ 601/ 2	NTIS (US Sales Only), PC A04/MF A01	DE87780051	MN -78	12:11204
IITRI-L-				
06139	*See* AD-A-173549/7/XAB			12:12517
IMOU-R-				
86-10	*See* ECN-186		ND -11	12:12234
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INIS-BR-				
541	NTIS (US Sales Only), PC A08/MF A01	DE87700381	MN -34C	12:12764
543	NTIS (US Sales Only), PC A08/MF A01	DE87700350	MN -34A	12:12839
544	NTIS (US Sales Only), PC A09/MF A01	DE87700415	MN -86	12:10911
545	NTIS (US Sales Only), PC A08/MF A01	DE87700413	MN -4	12:11889
546	NTIS (US Sales Only), PC A06/MF A01	DE87700417	MN -25	12:11622
547	NTIS (US Sales Only), PC A09/MF A01	DE87700422	MN -51	12:12282
548	NTIS (US Sales Only), PC A10/MF A01	DE87700423	MN -51	12:12283
549	NTIS (US Sales Only), PC A14/MF A01	DE87700427	MN -51	12:10900
550	NTIS (US Sales Only), PC A04/MF A01	DE87700428	MN -51	12:10901
551	NTIS (US Sales Only), PC A02/MF A01	DE87700429	MN -51	12:10902
552	NTIS (US Sales Only), PC A02/MF A01	DE87700430	MN -51	12:10903
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557	NTIS (US Sales Only), PC A04/MF A01	DE87700424	MN -51	12:12284
558	NTIS (US Sales Only), PC A02/MF A01	DE87700440	MN -48	12:12334
559	NTIS (US Sales Only), PC A12/MF A01	DE87700441	MN -48	12:12477
560	NTIS (US Sales Only), PC A06/MF A01	DE87700434	MN -51	12:10907
561	NTIS (US Sales Only), PC A02/MF A01	DE87700435	MN -51	12:11755
562	NTIS (US Sales Only), PC A02/MF A01	DE87700407	MN -4	12:12535
566	NTIS (US Sales Only), PC A99/MF A01	DE87700425	MN -51	12:12287
567	NTIS (US Sales Only), PC A06/MF A01	DE87700442	MN -48	12:12441
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10497	NTIS (US Sales Only), PC A06/MF A01	DE87780055	MN -41	12:12510
10519	NTIS (US Sales Only), PC A04/MF A01	DE87700408	MN -4	12:11756
10525	NTIS (US Sales Only), PC A05/MF A01	DE87700443	MN -41	12:11376
INIS-SU-				
365	NTIS (US Sales Only), PC A04/MF A01	DE87780050	MN -34D	12:12890
369	NTIS (US Sales Only), PC A19/MF A01	DE87780052	MN -28	12:12019
392	NTIS (US Sales Only), PC A99/MF A01	DE87780053	MN -34C	12:12691
INIS-XN-				
54	NTIS (US Sales Only), PC A03/MF A01	DE87700438	MN -48	12:12511
INPE-				
3810	NTIS (US Sales Only), PC A03/MF A01	DE87700360	MN -20	12:12923
3883	NTIS (US Sales Only), PC A02/MF A01	DE87700426	MN -51	12:12290
3914	NTIS (US Sales Only), PC A03/MF A01	DE87700357	MN -20	12:12924
IPT-				
1563	NTIS (US Sales Only), PC A04/MF A01	DE87700436	MN -51	12:12554
IRD-				
86/ 17	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -66	12:11090
IS-M-				
589	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87001837	MN -25	12:11716
IS-T-				
1277	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87003053	MN -4	12:11776
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07/ 85	NTIS, PC A07/MF A01			12:12925
ITEF-				
33-1985	NTIS (US Sales Only), PC A02/MF A01	DE87700356	MN -20	12:12926
56-1984	NTIS (US Sales Only), PC A02/MF A01	DE87700376	MN -34D	12:12632
ITEP-				
42-1985	NTIS (US Sales Only), PC A02/MF A01	DE87700327	MN -34D	12:12667

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87-1985	NTIS (US Sales Only), PC A02/MF A01	DE87700333	MN -34D	12:12668
88-1985	NTIS (US Sales Only), PC A02/MF A01	DE87700382	MN -34C	12:12806
95-1985	NTIS (US Sales Only), PC A02/MF A01	DE87700328	MN -34D	12:12669
100-1985	NTIS (US Sales Only), PC A03/MF A01	DE87700326	MN -34D	12:12670
114-1985	NTIS (US Sales Only), PC A02/MF A01	DE87700375	MN -34D	12:12633
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85-51-R	NTIS (US Sales Only), PC A03/MF A01	DE87700368	MN -34D	12:12654
85-52-R	NTIS (US Sales Only), PC A03/MF A01	DE87700361	MN -20	12:12927
85-75-R	NTIS (US Sales Only), PC A02/MF A01	DE87700386	MN -34C	12:12807
85-76-R	NTIS (US Sales Only), PC A02/MF A01	DE87700387	MN -34C	12:12808
85-85-R	NTIS (US Sales Only), PC A03/MF A01	DE87700323	MN -34D	12:12891
85-86-R	NTIS (US Sales Only), PC A02/MF A01	DE87700388	MN -34C	12:12809
85-92-R	NTIS (US Sales Only), PC A02/MF A01	DE87700389	MN -34C	12:12810
85-95-R	NTIS (US Sales Only), PC A02/MF A01	DE87700351	MN -34A	12:12892
85-121-R	NTIS (US Sales Only), PC A03/MF A01	DE87700365	MN -34B	12:12568
85-125-R	NTIS (US Sales Only), PC A02/MF A01	DE87700384	MN -34C	12:12811
85-130-R	NTIS (US Sales Only), PC A02/MF A01	DE87700385	MN -34C	12:12812
85-139-R	NTIS (US Sales Only), PC A02/MF A01	DE87700329	MN -34D	12:12671
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85-18-E	NTIS (US Sales Only), PC A02/MF A01	DE87700390	MN -34C	12:12813
85-19-E	NTIS (US Sales Only), PC A02/MF A01	DE87700383	MN -34C	12:12814
85-25-E	NTIS (US Sales Only), PC A02/MF A01	DE87700391	MN -34C	12:12815
85-26-E	NTIS (US Sales Only), PC A02/MF A01	DE87700370	MN -34D	12:12655
85-38-E	NTIS (US Sales Only), PC A02/MF A01	DE87700371	MN -34D	12:12816
85-53-E	NTIS (US Sales Only), PC A02/MF A01	DE87700372	MN -34D	12:12634
85-59-E	NTIS (US Sales Only), PC A02/MF A01	DE87700392	MN -34C	12:12817
85-99-E	NTIS (US Sales Only), PC A02/MF A01	DE87700373	MN -34D	12:12656
85-122-E	NTIS (US Sales Only), PC A02/MF A01	DE87700369	MN -34D	12:12657
IVEM-				
8	Interfakultaire Vakgroep Energie en Milieukunde Rijksuniversiteit, P.O. Box 72, 9700 AB Groningen, Netherlands		ND -98	12:11435
IWS-				
134.15	*See* PB-87-108346/XAB			12:12259
JINR-				
16-85-710	NTIS (US Sales Only), PC A02/MF A01	DE87700455	MN -28	12:12161
E-1-85-231	NTIS (US Sales Only), PC A02/MF A01	DE87700400	MN -34C	12:12718
E-1-85-415	NTIS (US Sales Only), PC A03/MF A01	DE87700377	MN -34D	12:12635
E-1-85-662	NTIS (US Sales Only), PC A02/MF A01	DE87700397	MN -34C	12:12705
E-2-85-732	NTIS (US Sales Only), PC A02/MF A01	DE87700334	MN -34D	12:12672
E-3-85-226	NTIS (US Sales Only), PC A02/MF A01	DE87700401	MN -34C	12:12719
E-4-85-525	NTIS (US Sales Only), PC A02/MF A01	DE87700317	MN -34D	12:12893
E-4-85-526	NTIS (US Sales Only), PC A02/MF A01	DE87700335	MN -34D	12:12673
E-4-85-705	NTIS (US Sales Only), PC A03/MF A01	DE87700319	MN -34D	12:12894
E-7-85-575	NTIS (US Sales Only), PC A03/MF A01	DE87700393	MN -34C	12:12818
R-1-85-315	NTIS (US Sales Only), PC A03/MF A01	DE87700396	MN -34C	12:12819
R-1-85-590	NTIS (US Sales Only), PC A02/MF A01	DE87700402	MN -34C	12:12720
R-1-85-668	NTIS (US Sales Only), PC A02/MF A01	DE87700395	MN -34C	12:12820
R-3-85-451	NTIS (US Sales Only), PC A02/MF A01	DE87700403	MN -34C	12:12721
R-4-85-250	NTIS (US Sales Only), PC A02/MF A01	DE87700336	MN -34A	12:12590
R-6-85-211	NTIS (US Sales Only), PC A02/MF A01	DE87700404	MN -34C	12:12732
R-9-85-567	NTIS (US Sales Only), PC A02/MF A01	DE87700453	MN -28	12:12047
R-9-85-593	NTIS (US Sales Only), PC A02/MF A01	DE87700454	MN -28	12:12048
R-11-85-309	NTIS (US Sales Only), PC A02/MF A01	DE87700457	MN -80	12:11240
K/CSD/INF-				
86/ 19P	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87000760	MN -13	12:12969
K/CSD/TM-				
64	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87004231	MN -32	12:12990
K/TS-				
11801	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003556	MN -25	12:11625
KFK-PEF-				
4(Vol.3)	NTIS (US Sales Only), PC A12/MF A01; 1	DE87750298	MN -11	12:12247
KFKI-				
1986-77/ E	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900268	MN -25	12:11626
1986-78/ E	NTIS (US Sales Only), PC A02/MF A01; 1	DE87900269	MN -25	12:11627
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84-1	NTIS (US Sales Only), PC A02/MF A01	DE87700398	MN -34C	12:12706
84-13	NTIS (US Sales Only), PC A03/MF A01	DE87700420	MN -25	12:11628
84-24	NTIS (US Sales Only), PC A03/MF A01	DE87700409	MN -4	12:11777
84-27	NTIS (US Sales Only), PC A02/MF A01	DE87700394	MN -34C	12:12821
85-8	NTIS (US Sales Only), PC A02/MF A01	DE87700421	MN -25	12:11629
85-10	NTIS (US Sales Only), PC A02/MF A01	DE87700354	MN -20	12:12928
85-11	NTIS (US Sales Only), PC A02/MF A01	DE87700367	MN -34D	12:12658
85-16	NTIS (US Sales Only), PC A02/MF A01	DE87700343	MN -34A	12:11717
KNMI-WR-				
6-1	NTIS, PC A03/MF A01			12:12248
KTM/E-D-				
99	NTIS (US Sales Only), PC A05/MF A01; 1	DE87750659	MN -95f	12:11567
100	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750650	MN -95d	12:11523
101	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750660	MN -90	12:10693
102	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750651	MN -95d	12:11424
103	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750661	MN -95f	12:11568
104	NTIS (US Sales Only), PC A13/MF A01; 1	DE87750653	MN -11	12:11425
105	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750652	MN -95d	12:11576

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L-				
16183	*See* N-87-11589			12:12205
LA-				
167/ 86	*See* OEFZS-4372	DE87700439	MN -48	12:12309
10045-Rev.	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87003810	MN -15	12:10984
10674-MS	NTIS, PC A05/MF A01	DE87003660	STD -32	12:12865
10685-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003796	MN -66b	12:11087
10697-MS	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE87002997	STD -33A	12:10990
10715-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87003807	STD -32	12:12866
10760-MS	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87003575	STD -2	12:11441
10784-MS	NTIS, PC A02; 3	DE87003811	MN -66b	12:11088
10793-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003496	STD -15	12:11778
10802-MS	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87003802	STD -70	12:12558
10812-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87003803	STD -41	12:12532
10813-MS	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87003809	STD -4	12:11779
10835-PR	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003800	STD -11	12:12338
10840-T	NTIS PC E08/MF A01 (GPO Dep.)	E 1.99: DE87003797	MN -66	12:12561
10842-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003808	STD -15	12:10985
10853-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003661	STD -34	12:12610
10854-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003804	STD -34	12:11992
10862-T	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87003799	STD -66c	12:11093
10873-M	NTIS, PC A02; 3	DE87003798	STD -32	12:12227
10898-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003805	STD -32	12:12991
10899-SR	NTIS, PC A03/MF A01; 1	DE87003806	STD -32	12:12970
LA-tr-				
86-40	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87003944	MN -25	12:11697
LA-UR-				
86-2600	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87003612	MN -13	12:12971
86-3493	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001961	MN -37	12:12204
86-3512	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001962	MN -34B	12:12569
86-3572	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87001968	MN -38	12:11583
86-3628	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87001976	MN -32	12:12992
86-3777	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002920	MN -41	12:12857
86-3778	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002919	MN -4	12:11816
86-3785	NTIS, PC AA02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002918	MN -34A	12:12611
86-3796	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002915	MN -34B	12:12570
86-3827	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002910	MN -34	12:12867
86-3946	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002901	MN -34C	12:12636
86-3978	NTIS, PC A02; 3	DE87002900	MN -25	12:11630
LAFI-				
071	NTIS (US Sales Only), PC A03/MF A01	DE87700405	MN -34C	12:12733
077	NTIS (US Sales Only), PC A02/MF A01	DE87700344	MN -34A	12:11631
079	NTIS (US Sales Only), PC A02/MF A01	DE87700352	MN -34A	12:12841
LBL-				
90-Rev.	NTIS, PC A25; 3	DE87003621	STD -34D	12:12637
17376	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87002576	MN -95d	12:11524
21294	NTIS, PC A02; 3	DE87002565	MN -28	12:12162
21899	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87001885	MN -4	12:11908
21941	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87003521	MN -34A	12:12868
22024	*See* NUREG/CR-4761	TI87003860	MN -78	12:11406
22026	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE87003533	MN -25	12:11632
22057	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000077	MN -25	12:11593
22126	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87003453	MN -25	12:11817
22296	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003541	MN -28	12:12954
22356	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87003637	MN -4	12:11872
22372	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE87003627	STD -95d	12:11525
LBL-PUB-				
445-6/ 86	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87000180	MN -13	12:12972
3061	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003553	MN -32	12:12993
LFE-				
85018	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750604	MN -96	12:11586
86006	*See* ERL-86006	DE87750592	MN -96	12:11548
LRP-				
304/ 86	NTIS (US Sales Only), PC A03/MF A01	DE87900205	MN -20	12:12929
MF-				
111	*See* DOE/ER/53223-17	E 1.99: DE87003419	MN -20f	12:12914
MINTEK-M-				
269	NTIS (US Sales Only), PC A03/MF A01	DE87900429	MN -25	12:11780
MLM-				
3400(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003024	MN -25	12:11718
3401	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004040	STD -25	12:11594
3403	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004041	STD -25	12:11595
3404	NTIS, PC A04/MF A01; 1	DE87004027	STD -70	12:10940
3405	NTIS, PC AA02/MF A01; 4	DE87004142	STD -25	12:11719
MS-				
7096	*See* AD-A-172605/8/XAB			12:11947
MSC-TFR-				
1607/ 0211	*See* N-86-31666			12:11720
MST-LUFT-A-				
102	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750597	MN -11	12:12249
MTL-TR-				
86-29	*See* AD-A-172367/5/XAB			12:11704
N-				
12-85	*See* INIS-SU-365	DE87780050	MN -34D	12:12890

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86-31647	NTIS, PC A05/MF A01				12:11578
86-31648	NTIS, PC A02/MF A01				12:11633
86-31654	NTIS, PC A03/MF A01				12:12013
86-31666	NTIS, PC A06/MF A01				12:11720
86-32888	NTIS, PC A02/MF A01				12:11113
86-33032	NTIS, PC A02/MF A01				12:12994
87-11511	NTIS, PC A03/MF A01				12:12995
87-11589	NTIS, PC A02/MF A01				12:12205
87-11651	NTIS, PC A02/MF A01				12:12571
87-11652	NTIS, PC A02/MF A01				12:12572
87-11653	NTIS, PC A02/MF A01				12:12573
87-11671	NTIS, PC A04/MF A01				12:11818
NAGRA-NGB-					
85-01	NTIS (US Sales Only), PC A14/MF A01; 1		DE87900398	MN -70	12:10941
NAGRA-NTB-					
83-22	NTIS (US Sales Only), PC A03/MF A01		DE87900397	MN -70	12:10981
84-28	NTIS (US Sales Only), PC A03/MF A01; 1		DE87900399	MN -70	12:10942
NAS-					
1.15:88995	*See* N-87-11589				12:12205
1.26:4016	*See* N-86-31666				12:11720
1.26:174970	*See* N-86-31648				12:11633
1.26:178893	*See* N-86-31654				12:12013
1.26:178897	*See* N-86-31647				12:11578
1.26:179699	*See* N-86-33032				12:12994
1.26:179784	*See* N-87-11651				12:12571
1.26:179865	*See* N-87-11653				12:12573
1.26:179879	*See* N-87-11652				12:12572
1.26:179881	*See* N-87-11671				12:11818
1.26:179889	*See* N-87-11511				12:12995
NASA-CR-					
4016	*See* N-86-31666				12:11720
174970	*See* N-86-31648				12:11633
178893	*See* N-86-31654				12:12013
178897	*See* N-86-31647				12:11578
179559	*See* DOE/NASA/0181	E 1.99:	DE87003993	MN -96	12:11065
179699	*See* N-86-33032				12:12994
179784	*See* N-87-11651				12:12571
179865	*See* N-87-11653				12:12573
179879	*See* N-87-11652				12:12572
179881	*See* N-87-11671				12:11818
179889	*See* N-87-11511				12:12995
NASA-E-					
2711	*See* AD-A-173358/3/XAB				12:11579
NASA-TM-					
88892	*See* DOE/NASA/16310-1	E 1.99:	DE87003578	STD -25	12:11615
88995	*See* N-87-11589				12:12205
NATICK/TR-					
86/ 062	*See* AD-A-172878/1/XAB				12:11917
NAVHLTHRSCHC-					
86-9	*See* AD-A-173275/9/XAB				12:11591
NBSIR-					
86/ 3461	*See* PB-87-116141/XAB				12:12638
NERDDP-EG-					
85-495	Department of Resources and Energy, GPO Box 858, Canberra, Australia 2601				12:10783
NIIAR-					
18(664)	NTIS (US Sales Only), PC A02/MF A01		DE87700418	MN -25	12:11634
NIIEFA-P-B-					
0698	NTIS (US Sales Only), PC A02/MF A01		DE87700363	MN -20	12:12955
NIPER-					
152	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001205	STD -92b	12:10876
173	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001203	STD -92a	12:10854
180	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87001201	STD -92a	12:10855
188	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001204	STD -92b	12:11819
202	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002028	MN -92b	12:10877
207	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002025	MN -92b	12:10878
213	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87004136	MN -92a	12:10856
NLR-MP-					
85071-U	*See* N-86-32888				12:11113
NMRDI-					
2-74-4806	NTIS, PC A08/MF A01 - NMRDI, Suite M, 457 Washington SE, Albuquerque, NM 87108; 1		DE87900413	MN -92a	12:10857
NP-					
7750591	NTIS (US Sales Only), PC A05/MF A01; 1		DE87750591	MN -95d	12:11526
7750594	NTIS (US Sales Only), PC A02; 3		DE87750594	MN -95	12:11569
7750595	NTIS (US Sales Only), PC A04/MF A01; 1		DE87750595	MN -95d	12:11527
7750601	NTIS (US Sales Only), PC A02/MF A01; 1		DE87750601	MN -60	12:11114
7750605	NTIS (US Sales Only), PC A05/MF A01; 1		DE87750605	MN -97e	12:11018
7750606	NTIS (US Sales Only), PC A11; 3		DE87750606	MN -97e	12:11019
7750607	NTIS (US Sales Only), PC A03/MF A01; 1		DE87750607	MN -97e	12:11100
7750608	NTIS (US Sales Only), PC A02/MF A01		DE87750608	MN -94cc	12:11421
7750612	NTIS (US Sales Only), PC A05/MF A01; 1		DE87750612	MN -95d	12:11570
7750629	NTIS (US Sales Only), PC A03/MF A01; 1		DE87750629	MN -95d	12:11528
7750635	NTIS (US Sales Only), PC A11/MF A01; 1		DE87750635	MN -98	12:11453

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7900159	NTIS (US Sales Only), PC A14/MF A01; 1	DE87900159	MN -70	12:10964
7900318	NTIS (US Sales Only), PC A04/MF A01; 1	DE87900318	MN -95f	12:11476
7900343	North Carolina Dept. of Commerce., 430 N. Salisbury St., Raleigh, NC 27611	TI87900343	MN -05	12:11428
7900351	NTIS (US Sales Only), PC A07/MF A01; 1	DE87900351	MN -13	12:11442
7900411	NTIS (US Sales Only), PC A10; 3	DE87900411	MN -59A	12:11084
7900438	Alaska Power Authority, P.O. Box 190869, 701 E. Tudor Rd., Anchorage, AK 99519-0869	TI87900438	MN -98	12:11477
NRCC-				
24797	*See* ARL-TR-53			12:10742
NRL-MR-				
1351	*See* AD-A-955141/7/XAB			12:11601
5770	*See* AD-A-172580/3/XAB			12:11946
5829	*See* AD-A-172612/4/XAB			12:12940
5835	*See* AD-A-173539/8/XAB			12:12581
5847	*See* AD-A-172906/0/XAB			12:12577
NTB-				
85-26	Nagra, Ch-5401 Baden, Switzerland		ND -51	12:12307
NUCLEBRAS-CDTN-				
488	NTIS (US Sales Only), PC A02/MF A01	DE87700459	MN -80	12:11247
490	NTIS (US Sales Only), PC A02/MF A01	DE87700410	MN -4	12:11781
527	NTIS (US Sales Only), PC A07/MF A01	DE87700411	MN -4	12:11782
531	NTIS (US Sales Only), PC A02/MF A01	DE87700412	MN -4	12:11783
534	NTIS (US Sales Only), PC A02/MF A01	DE87700461	MN -80	12:11307
538	NTIS (US Sales Only), PC A02/MF A01	DE87700414	MN -86	12:11784
545	NTIS (US Sales Only), PC A02/MF A01	DE87700445	MN -41	12:11891
549	NTIS (US Sales Only), PC A02/MF A01	DE87700437	MN -11	12:12320
NUREG-				
0020-Vol.10-No.7	NTIS, PC A19/MF A01 - GPO	TI87900278	MN -80	12:11236
0386-Digest.4-Rev.3	NTIS, PC A20/MF A01 - GPO	TI87900246	MN -2	12:11237
0683-Suppl.2	NTIS, PC A07/MF A01 - GPO	TI87900404	MN -78	12:11377
0829-Final	NTIS, PC A25/MF A01 - GPO	TI87900395	MN -78	12:11378
1107-Add.	NTIS, PC A02/MF A01 - GPO	TI87900320	MN -78	12:11231
1137-Suppl.4	NTIS, PC A09/MF A01 - GPO	TI87900417	MN -78	12:11379
1197	NTIS, PC A04/MF A01 - GPO	TI87900415	MN -78	12:11380
1227	NTIS, PC A05/MF A01 - GPO	TI87900406	MN -11	12:12308
1241	NTIS, PC A03/MF A01 - GPO	TI87900412	MN -70B	12:10988
NUREG/CP-				
0081	NTIS, PC A13/MF A01 - GPO; 1	TI87900064	MN -78	12:11399
NUREG/CR-				
3469-Vol.3	NTIS, PC A06/MF A01 - GPO	TI87003791	MN -41	12:12512
4016-Vol.2	NTIS, PC A10/MF A01 - GPO	TI87003422	MN -80	12:11400
4499	NTIS, PC A03/MF A01 - GPO	TI87004001	MN -78	12:11401
4550-Vol.7	NTIS, PC A06/MF A01 - GPO	TI87003410	MN -78	12:11402
4573	NTIS, PC A10/MF A01 - GPO	TI87900350	MN -25	12:11635
4591	NTIS, PC A08/MF A01 - GPO	TI87003862	MN -32	12:12996
4638/ 1	NTIS, PC A05/MF A01 - GPO	TI87002999	MN -80	12:11261
4658	NTIS, PC A03/MF A01 - GPO	TI87003990	MN -83	12:10982
4674-Vol.1	NTIS, PC A11/MF A01 - GPO	TI87003939	MN -78	12:11403
4674-Vol.2	NTIS, PC A99 - GPO; 3	DE87003936	MN -78	12:11404
4680	NTIS, PC A04/MF A01 - GPO	TI87003218	MN -80	12:11405
4693	NTIS, PC A04/MF A01 - GPO	TI87003446	MN -70	12:10943
4714	NTIS, PC A11/MF A01 - GPO	TI87003905	MN -70B	12:11721
4717	NTIS, PC A05/MF A01 - GPO	TI87003403	MN -78	12:11322
4754	NTIS, PC A05/MF A01 - GPO	TI87003813	MN -41	12:12513
4761	NTIS, PC A09/MF A01 - GPO	TI87003860	MN -78	12:11406
4782	NTIS, PC A03/MF A01 - GPO	TI87900405	MN -25	12:11636
4792-Vol.3	NTIS, PC A09/MF A01 - GPO	TI87003765	MN -78	12:11407
4806	NTIS, PC A04/MF A01 - GPO	TI87900393	MN -78	12:11217
NZERDC-				
131	NTIS (US Sales Only), MF A01; 2	DE87900433	MN -98	12:11454
133	NTIS (US Sales Only), PC A06; 3	DE87900432	MN -90e	12:10829
OA-Trans-				
2767	Electricity Council, 30 Millbank, London SW1P 4RD		ND -95f	12:11571
OEFZS-				
345	NTIS, PC A03/MF A01			12:11722
4371	NTIS (US Sales Only), PC A02/MF A01	DE87700444	MN -41	12:12206
4372	NTIS (US Sales Only), PC A02/MF A01	DE87700439	MN -48	12:12309
4373	NTIS (US Sales Only), PC A03/MF A01	DE87700449	MN -71	12:10944
4374	NTIS (US Sales Only), PC A02/MF A01	DE87700450	MN -71	12:10945
ONERA-NT-				
1984-3	*See* ESA-TT-10			12:11907
ORNL-				
6261	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE86011391	STD -4	12:11748
6302	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87004025	STD -25	12:11725
6309	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87004057	MN -96	12:11549
ORNL/CON-				
193	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87004051	STD -95d	12:11529
216	NTIS, PC A05/MF A01; 1	DE87004021	MN -95d	12:11530
222	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87004037	MN -95d	12:11531
ORNL/EIS-				
154/ V7	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99: DE87002853	MN -70A	12:10946

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ORNL/ESH-					
1/ V21	NTIS, PC A03/MF A01; 1		DE87004049	ND -11	12:12339
1/ V22	NTIS, PC A11/MF A01; 1		DE87004033	MN -11	12:12317
ORNL/FMP-					
86/ 4	NTIS, PC A18/MF A01; 1		DE87004050	MN -90	12:10694
ORNL/M-					
255	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003943	MN -11	12:11461
260	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002877	MN -80	12:11408
261	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003942	MN -41	12:11462
ORNL/NOAC-					
232/ V1	*See* NUREG/CR-4674-Vol.1		TI87003939	MN -78	12:11403
232/ V2	*See* NUREG/CR-4674-Vol.2		DE87003936	MN -78	12:11404
ORNL/Sub-					
85-22006/ 1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004000	MN -90h	12:11637
ORNL/TM-					
9494	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87004048	STD -20f	12:12930
9680-Pt.3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004028	STD -70	12:10947
9865	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004035	MN -11	12:10948
9999	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003978	MN -70	12:12536
10106	NTIS, PC A03/MF A01; 1		DE87004026	STD -38	12:12001
10126	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86015969	STD -20c	12:11638
10157	NTIS, PC A05/MF A01		DE87004055	ND -98C	12:11465
10159	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004022	MN -98C	12:11466
10172	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87004030	MN -32	12:12998
10201	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004024	MN -63	12:11046
10218	NTIS, PC A05/MF A01; 1		DE87004038	MN -70	12:11787
10237	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87004054	MN -48	12:12522
10238	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004039	MN -48	12:12405
10251	NTIS, PC A02/MF A01		DE87004044	MN -48	12:12523
10293	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003935	MN -97	12:11201
10299	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004046	STD -70	12:10949
ORNL/tr-					
86/ 77	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003981	MN -86	12:10918
ORO-					
4014-16	*See* DOE/ER/04014-16	E 1.99:	DE87003316	MN -80	12:11321
5126-302	*See* DOE/ER/05126-302		DE87002267	MN -34C	12:12756
5172-0028	*See* DOE/ER/05172-0028	E 1.99:	DE87003914	MN -34C	12:12702
OTA-E-					
279	*See* PB-87-100350/XAB				12:10766
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4,626,281					12:11643
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4,626,401					12:12264
4,626,448					12:11641
4,626,708					12:12010
4,626,791					12:12207
4,626,832					12:11075
4,627,068					12:11967
PATR-					
213-1	*See* AD-A-172489/7/XAB				12:12221
PB-					
87-100350/ XAB	NTIS, PC A14/MF A01				12:10766
87-100467/ XAB	NTIS PC PC E03/MF E01				12:10950
87-105581/ XAB	NTIS, PC A02/MF A01				12:10731
87-106191/ XAB	NTIS, PC A10/MF A01				12:10837
87-106241/ XAB	NTIS, PC A12/MF A01				12:12524
87-106480/ XAB	NTIS, PC A03/MF A01				12:12250
87-106514/ XAB	NTIS, PC A03/MF A01				12:12251
87-106886/ XAB	NTIS, PC A02/MF A01				12:12525
87-106985/ XAB	NTIS, PC A04/MF A01				12:11010
87-107033/ XAB	NTIS, PC A03/MF A01				12:12252
87-107546/ XAB	NTIS, PC A99/MF A01				12:12321
87-107553/ XAB	NTIS, PC A05/MF A01				12:11550
87-108023/ XAB	NTIS, PC A03/MF A01				12:12253
87-108031/ XAB	NTIS, PC A02/MF A01				12:12254
87-108049/ XAB	NTIS, PC A03/MF A01				12:12255
87-108056/ XAB	NTIS, PC A03/MF A01				12:12256
87-108064/ XAB	NTIS, PC A03/MF A01				12:12257
87-108320/ XAB	NTIS, PC A03/MF A01				12:12258
87-108338/ XAB	NTIS, PC A06/MF A01				12:12430
87-108346/ XAB	NTIS, PC A02/MF A01				12:12259
87-110656/ XAB	NTIS, PC A10/MF A01				12:12294
87-114112/ XAB	NTIS, PC A05/MF A01				12:10887
87-116141/ XAB	NTIS, PC A06/MF A01				12:12638
87-116265/ XAB	NTIS, PC A04/MF A01				12:11584
87-119343/ XAB	NTIS, PC A03/MF A01				12:11191
86112349	NTIS, PC A05/MF A01		TI87900459	MN -13	12:13013
PER-					
95	NTIS (US Sales Only), PC A07/MF A01		DE87700265	MN -51	12:10908

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PFC/RR-					
86-5	*See* DOE/PC/70512-5	E 1.99:	DE87003101	MN -90g	12:11484
PML-					
1984-C-38	Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands			ND -90i	12:10767
1984-C83	Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands			ND -90i	12:10768
PNL-					
5733	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87003963	MN -90	12:11788
5827	*See* NUREG/CR-4591		TI87003862	MN -32	12:12996
5844	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004217	MN -61D	12:11002
5910	*See* NUREG/CR-4658		TI87003990	MN -83	12:10982
5971	*See* NUREG/CR-4717		TI87003403	MN -78	12:11322
5974	NTIS, PC A08/MF A01; 1		DE87004029	STD -85	12:10914
6025	*See* NUREG/CR-4754		TI87003813	MN -41	12:12513
6047	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004220	MN -70B	12:10979
6049-Vol.1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003966	STD -85	12:10915
6051	NTIS, PC A04/MF A01; 1		DE87004053	MN -70B	12:10951
6074	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004221	STD -85	12:10916
6080	NTIS, PC A08/MF A01		DE87004045	MN -95d	12:11532
6096	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87003971	MN -25	12:11639
PNL-SA-					
13687	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87002062	MN -41	12:12858
13806	NTIS, PC A02; 3		DE87003305	MN -11	12:12260
13833	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003303	MN -11	12:12555
14040	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002472	MN -4	12:11869
14084	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003306	MN -34A	12:12591
14187	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003405	MN -41	12:12514
14415	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003098	MN -41	12:12515
PPPL-					
2401	NTIS, PC A08/MF A01; 1		DE87004047	STD -20g	12:12931
PREPRINT-					
88	NTIS, PC A02/MF A01				12:12659
PUC-TN-					
25/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700345	MN -34A	12:11726
31/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700337	MN -34A	12:12592
32/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700330	MN -34D	12:12674
33/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700346	MN -34A	12:11727
34/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700347	MN -34A	12:11640
35/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700348	MN -34A	12:11728
36/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700349	MN -34A	12:11729
37/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700338	MN -34A	12:12612
39/ 84	NTIS (US Sales Only), PC A02/MF A01		DE87700340	MN -34A	12:12593
R-					
508	*See* PB-87-100467/XAB				12:10950
RAND/R-					
2569/ 1-DOE	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003672	MN -69	12:11912
REPT-					
5-46	NTIS, PC A02/MF A01				12:12999
5-49	NTIS, PC A03/MF A01				12:11429
0737P-105	*See* N-86-31647				12:11578
-4098-39-05	NTIS, PC A04/MF A01				12:11102
RF-T-					
46/ 84	NTIS (US Sales Only), PC A05; 3		DE87750634	MN -92	12:10858
47/ 84	NTIS (US Sales Only), PC A05/MF A01; 1		DE87750633	MN -92a	12:10859
RI/RD-					
86-226	*See* N-86-31647				12:11578
RISO-M-					
2547	NTIS (US Sales Only), PC A03/MF A01; 1		DE87750596	MN -60	12:11115
2606	NTIS (US Sales Only), PC A08/MF A01; 1		DE87750598	MN -98	12:11430
RISO-R-					
467	NTIS (US Sales Only), PC A04/MF A01; 1		DE87750610	MN -11	12:12235
535	NTIS (US Sales Only), PC A05/MF A01; 1		DE87750602	MN -60	12:11103
RLO/SFM-					
80/ 5-Vol.7	*See* ORNL/EIS-154/V7	E 1.99:	DE87002853	MN -70A	12:10946
SAND-					
85-2422	NTIS, PC A06/MF A01; 1		DE86014082	STD -62a	12:11066
85-2827	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003780	STD -71	12:10917
86-0289	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003583	STD -62b	12:11067
86/ 0312	*See* NUREG/CR-4680		TI87003218	MN -80	12:11405
86-0369	NTIS, PC A03/MF A01; 1		DE87003964	ND -70	12:10952
86-0395	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003280	STD -37	12:12228
86-0538	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003290	STD -66d	12:11097
86-0586C	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86012655	MN -32	12:13000
86-0827	NTIS, PC A03/MF A01; 2 (GPO Dep.)	E 1.99:	DE87003782	STD -32	12:13001
86-0839/ 1	*See* NUREG/CR-4638/1		TI87002999	MN -80	12:11261
86-1329	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003620	STD -70	12:11730
86-1598	*See* NUREG/CR-4693		TI87003446	MN -70	12:10943
86-2084-Vol.7	*See* NUREG/CR-4550-Vol.7		TI87003410	MN -78	12:11402
86-2129C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002487	MN -78	12:11409
86-2458C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002051	MN -38	12:11960
86-2485C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87001735	MN -34	12:11961
86-2487C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003153	MN -25	12:11731
86-2488C	NTIS, PC A02; 3		DE87003040	MN -25	12:11688

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86-2501C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87002699	MN -25	12:12594
86-2623C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002482	MN -38	12:12002
86-2633	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87003965	MN -32	12:13002
86-2773C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003029	MN -98B	12:10868
86-7108	*See* NUREG/CR-4499	T187004001	MN -78	12:11401
86-7157	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003960	MN -70	12:10953
86-7171	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003959	MN -70	12:10954
86-7173	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87003961	MN -70	12:10955
86-8248	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004229	MN -25	12:11732
SAPR-				
12	*See* N-87-11651			12:12571
SBI-R-				
172	Statens Byggeforskningsinsitut, P.O. Box 119, DK-2970 Hoersholm, Denmark. Price: Dkr. 90.00		ND -95d	12:11533
173	Statens Byggeforskningsinstitut, P.O. Box 119, DK-2970 Hoersholm, Denmark. Price: DKr. 74.75		ND -95d	12:11534
174	Statens Byggeforskningsinstitut, P.O. Box 119, DK-2970 Hoersholm, Denmark. Price: DKK. 99,75		ND -95d	12:11535
SC-				
410.FR	*See* AD-A-173342/7/XAB			12:11685
SCOAL-				
8601	National Institute for Coal Research, Pretoria, South Africa			12:10700
SERI/SP-				
271-2839	NTIS, PC A15/MF A01 (GPO Dep.)	E 1.99: DE86014515	MN -61D	12:11014
272-3008	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE86010728	STD -62	12:11068
SERI/STR-				
211-2978	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87001116	STD -63	12:11047
SGU-				
44	NTIS (US Sales Only), PC A06/MF A01; 1	DE87750623	MN -11	12:12326
SI-				
1-1985	Skovteknisk Institut		ND -61A	12:11048
SL-				
84913	NTIS (US Sales Only), PC A05/MF A01; 1	DE87750609	MN -60	12:11104
85924	NTIS (US Sales Only), PC A06/MF A01; 1	DE87750599	MN -96	12:11551
SLAC/AP-				
54	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003667	MN -28	12:12071
SLAC-PUB-				
3894	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003275	MN -32	12:13003
4054	NTIS, PC A02/MF A01; 1	DE87003669	ND -34D	12:12639
4109	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87002846	MN -38	12:12007
4126	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003671	MN -41	12:11939
4134	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003267	MN -34C	12:12699
4138	NTIS, PC A02; 3	DE87003269	MN -34D	12:12660
SLU-ESO-				
34	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750616	MN -61A	12:11049
37	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750617	MN -61A	12:11050
38	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750618	MN -61A	12:11051
39	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750619	MN -61A	12:11052
40	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750620	MN -61A	12:11053
SLU-IVL-				
180	*See* STEV-SB-86-22	DE87750632	MN -61A	12:11015
ST-				
140/ 86	*See* OEFZS-4371	DE87700444	MN -41	12:12206
STEV-				
1986-2	NTIS (US Sales Only), PC A10/MF A01; 1	DE87750621	MN -98	12:11455
1986-R7	NTIS (US Sales Only), PC A02/MF A01; 1	DE87750615	MN -90	12:11443
STEV-EO-				
86-5	NTIS (US Sales Only), PC A04; 3	DE87750626	MN -61A	12:11054
STEV-FBA-				
86-7	NTIS (US Sales Only), PC A03/MF A01	DE87750628	MN -90b	12:10788
86-8	NTIS (US Sales Only), PC A07/MF A01; 1	DE87750627	MN -92	12:10879
86-9	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750631	MN -95d	12:11536
STEV-FVE-				
86-2	NTIS (US Sales Only), PC A03/MF A01; 1	DE87750625	MN -66b	12:11098
STEV-NYEL-				
86-4	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750630	MN -97	12:11176
STEV-SB-				
86-22	NTIS (US Sales Only), PC A04/MF A01; 1	DE87750632	MN -61A	12.11015
STUDSVIK-EB-				
85-59	*See* STEV-FBA-86-7	DE87750628	MN -90b	12:10788
STUDSVIK-EP-				
86-15	*See* STEV-FBA-86-9	DE87750631	MN -95d	12:11536
THD-IW-				
R505	NTIS, PC A03/MF A01			12:11116
THD-WI-				
85-49	Delft Univ. of Technology, Dept. of Mathematics and Informatics, P.O. Box 356, 2600 AJ Delft, Netherlands		ND -98	12:11431
THE-R-				
738-D	*See* THD-IW-R505			12:11116
TKK-F-				
546	Helsinki University of Technology, Otaniemi, Finland			12:10836

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TKK-KO/LVI-					
B8	NTIS (US Sales Only), PC A07/MF A01; 1		DE87750655	MN -11	12:11537
B9	NTIS (US Sales Only), PC A06/MF A01; 1		DE87750654	MN -11	12:11538
C9	NTIS (US Sales Only), PC A05/MF A01; 1		DE87750656	MN -11	12:11539
C15	NTIS (US Sales Only), PC A06/MF A01; 1		DE87750657	MN -11	12:11540
C18	NTIS (US Sales Only), PC A08/MF A01; 1		DE87750658	MN -11	12:11541
TR-					
3	*See* AD-A-172802/1/XAB				12:11706
61	*See* AD-A-173055/5/XAB				12:11949
63	*See* AD-A-173147/0/XAB				12:11951
64	*See* AD-A-173461/5/XAB				12:11955
0086(6935-14) -1	*See* AD-A-172751/0/XAB				12:11705
TR-EL-					
82-4/ 82-11-62	NTIS, PC A03/MF A01		TI87900131	MN -11	12:12322
TRI-PP-					
86-89	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900302	MN -28	12:12163
86-90	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900312	MN -28	12:12164
86-92	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900313	MN -28	12:12072
86-93	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900314	MN -28	12:12165
86-94	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900309	MN -28	12:12073
86-96	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900310	MN -28	12:12074
86-97	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900308	MN -28	12:12166
86-98	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900307	MN -28	12:12049
86-107	NTIS (US Sales Only), PC A02/MF A01; 1		DE87900304	MN -28	12:12167
TRW-SN-					
44617	*See* DOE/PC/70815-T7	E 1.99:	DE87003353	MN -90e	12:10824
TTC-					
0635	*See* SAND-85-2827	E 1.99:	DE87003780	STD -71	12:10917
TTI-					
2-18-80-293	*See* PB-87-107553/XAB				12:11550
TVA/OACD-					
86/ 10	NTIS, PC A06/MF A01; 1		DE87003785	MN -61E	12:11011
86/ 12	NTIS, PC A04/MF A01; 1		DE87900348	MN -13	12:12463
TVA/ONRED/AWR-					
86/ 57	NTIS, PC A03/MF A01; 1		DE87900332	MN -11	12:12327
86/ 58	NTIS, PC A04/MF A01; 1		DE87900333	MN -11	12:12340
TVA/ONRED/LER-					
86/ 36	NTIS, PC A04/MF A01; 1		DE87900344	MN -61A	12:11055
87/ 11	NTIS, PC A03/MF A01; 1		DE87900342	MN -61A	12:11056
TVA/ONRED/WRF-					
86/ 6	NTIS, PC A02/MF A01		DE87900331	MN -11	12:11192
87/ 3	NTIS, PC A07/MF A01; 1		DE87900346	MN -11	12:12526
TVA/OP/CEM-					
86/ 29	NTIS MF A01; 2		DE87900329	MN -95d	12:11542
87/ 11	NTIS, PC A03/MF A01; 1		DE87900328	MN -05	12:11456
TVA/OP/EDT-					
86/ 39	NTIS, PC A07; 3		DE87900345	MN -97c	12:11202
TVA/OP/EUDR-					
86/ 7	NTIS, PC A04/MF A01; 1		DE87900340	MN -97	12:11474
TVA/OP/PMO-					
87/ 1	NTIS, PC A02/MF A01		DE87900341	MN -11	12:11438
TVA/PUB-					
87/ 3	NTIS, PC A02/MF A01; 1		DE87900349	MN -13	12:12464
87/ 4	NTIS, PC A02/MF A01		DE87900336	MN -61E	12:11012
87/ 5	NTIS, PC A02/MF A01		DE87900330	MN -11	12:12341
87/ 6	NTIS, PC A08/MF A01; 1		DE87900335	MN -11	12:12342
UCID-					
20863	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE87003975	MN -20	12:12956
20896	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003886	MN -32	12:13004
20914-Vol.3	*See* NUREG/CR-4792-Vol.3		TI87003765	MN -78	12:11407
20928	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003976	MN -13	12:13005
20940	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003977	MN -25	12:11940
UCRL-					
15623-85	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003889	MN -20	12:12957
15798	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003888	MN -25	12:11962
15835-Vol.1	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003891	MN -11	12:12328
15835-Vol.2	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003892	MN -11	12:12329
15854	NTIS, PC A05; 3		DE87003883	MN -11	12:12330
15856	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003885	MN -11	12:12331
50016-86-1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004218	STD -38	12:11913
50025-86-3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003973	STD -38	12:11914
53723	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003972	STD -20	12:12958
53773	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003974	MN -38	12:11941
93077	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003397	MN -38	12:12582
93786	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86016081	MN -21	12:12959
94217	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003394	MN -20a	12:12960
94382	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003257	MN -21	12:12961
94638	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003256	MN -21	12:12962
94737	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003253	MN -38	12:12003
94994	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003469	MN -11	12:12229
95043	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002756	MN -41	12:12859
95089	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003438	MN -38	12:11963
95092	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002160	MN -34C	12:12722
95134-Rev.1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87003249	MN -38	12:11942

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95327	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87000598	MN -38	12:11943
95396	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003252	MN -38	12:11964
95441	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002553	MN -32	12:13006
95481	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87002389	MN -41	12:12275
95516	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001359	MN -38	12:11965
95563	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87003245	MN -34A	12:12595
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RA Report analytic
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BA Book analytic
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D Dissertation
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TH Thailand
TN Tunisia
TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
VE Venezuela
VI Virgin Islands of the United States
VN Viet Nam

WS Western Samoa

YD Democratic Yemen
YE Yemen
YU Yugoslavia

ZA South Africa
ZM Zambia
ZR Zaire
ZW Zimbabwe

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